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UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Covering the Literature on Atomic Energy
in the Fields of

Biology · Medicine · Chemistry
Biophysics · Physics · Engineering
Metallurgy

Vol. 5 No. 4
Feb. 28, 1951

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NUCLEAR SCIENCE ABSTRACTS

Vol. 5 No. 4

Table of Contents for Feb. 28, 1951

Category	Abstract	Page
REPORTS REFERENCE LIST		iii
GENERAL	741	119
Atomic Bombs and Warfare	741	
BIOLOGY AND MEDICINE	742	119
Radiation Effects	744	
Radiation Hazards and Protection	752	
Radiation Sickness	759	
Radiotherapy	760	
Toxicology Studies	768	
Tracer Applications	769	
CHEMISTRY	774	124
Analytical Procedures	779	
Atomic Weights and Periodic Systems	786	
Crystallography and Crystal Structure	787	
Deuterium and Deuterium Compounds	789	
Fluorine and Fluorine Compounds	790	
Radiation Chemistry	798	
Radiation Effects	799	
Separation Procedures	801	
Sorption Phenomena	806	
Spectroscopy	807	
Syntheses	809	
Tracer Applications	811	
Uranium and Uranium Compounds	812	
ENGINEERING	817	131
Heat Transfer	817	
Vacuum Systems	819	
MINERALOGY, METALLURGY, AND CERAMICS	820	131
Ceramics and Refractories	820	
Geology and Geophysics	824	
Metals and Metallurgy	825	
Minerals and Mineralogy	832	
PHYSICS	836	134
Astrophysics	838	
Electrical Discharge	840	
Electrons	841	
Gases	843	
Instruments	844	
Isotopes	846	
Mathematics	847	
Measuring Instruments and Techniques	848	
Mesons	861	
Meteorology	865	
Molecular Properties	866	
Neutrons	867	
Nuclear Properties	869	

TABLE OF CONTENTS FOR FEBRUARY 28, 1951

Category	Abstract	Page
PHYSICS		
Nuclear Reactors	875	
Nuclear Transformation	876	
Particle Accelerators	879	
Radiation Absorption and Scattering	881	
Radioactivity	885	
Shielding	899	
Spectroscopy	900	
Theoretical Physics	901	
Tritium and Tritium Compounds	903	
AUTHOR INDEX		A
NUMERICAL INDEX OF AEC REPORTS		D
NNES ANNOUNCEMENTS		E

INDEXES IN VOLUME 5

Each issue of NSA, beginning with Volume 5 (1951), will contain an Author Index and a current supplement to the cumulative Numerical Index of AEC Reports. Quarterly (each sixth issue) there will be Subject and Nuclide Indexes cumulated for the preceding three months. The last issue of the volume will contain these indexes cumulated for the entire volume.

Erratum for NSA, Vol. 5, No. 2

In the "List of Contents of NNES Publications," page F, the name of Clement J. Rodden, editor-in-chief, was inadvertently omitted from the listing of "Analytical Chemistry of the Manhattan Project."

REPORTS REFERENCE LIST

Vol. 5, No. 4

U. S. ATOMIC ENERGY COMMISSION DECLASSIFIED REPORTS

Report	Title, Author	Abstract
AECD-2955	Progress Report on Carnotite Studies; Carbonate Process; Research and Development Division. K. B. Brown, C. F. Coleman, and C. D. Susano.	832
AECD-2975	The Design and Construction of Boron Coated Thermopiles for Use in Neutron Fields. Glenn Barbaras, John Farr, John Kuranz, Robert J. Moon, Leonard M. Rieser, George W. Schaeffer, and Thomas Wartek.	848
AECD-2981	The Reaction of UF_4 with Dry O_2; A New Synthesis of UF_6. S. Fried and N. R. Davidson.	812
AECD-2982	Note on Constant Current Regulators. E. E. Minett, D. A. MacRae, and J. Townsend.	844
AECD-2984	Some Problems in the Chemistry of Uranium and Thorium of Interest to the Development of Atomic Power. Robert William Nottorf.	814
AECD-2986	Removal of Submicron Aerosol Particles from a Moving Gas Stream by the Condensation Center Effect. P. J. Schauer.	752
AECD-2992	Activation Analysis by Means of the Oak Ridge Reactor. G. W. Leddicotte and S. A. Reynolds.	779
AECD-3003	The Development of Aluminum-6 Per Cent Magnesium Wrought Alloys for Elevated-Temperature Service. K. Grube and L. W. Eastwood.	825
AECD-3013	Test of Dense Concrete with Iron Punchings for Cave Construction. Donald F. Uecker, Kenneth R. Ferguson, Dudley G. Seay, and Charles B. Webster.	899
AECD-3014	Report on a Differential Ionization Chamber. James W. Broxon.	849
AECD-3015	The Trinitratouranyl Complex in Ketonic Solvents. L. Kaplan, R. A. Hildebrandt, and M. Ader.	813
AECD-3018	Total Neutron Cross Section of Thorium at 14 Mev. Albert H. Lasday.	869

U. S. ATOMIC ENERGY COMMISSION UNCLASSIFIED REPORTS

AECU-990	Allelism of Second Chromosome Lethals in D. Melanogaster. Bruce Wallace.	744
AECU-998	Pathways of Enamel Penetration and Tests of Impregnation with Radioactive Salts of Calcium^{45}, Zinc^{63,65}, Silver^{110,111}, Plutonium^{239}, Palladium^{103}, Iodine^{131}; and Copper^{64}. Wm. Ward Wainwright.	769
AECU-1000	Time Studies of the Penetration of Extracted Human Teeth by Radioactive Nicotinamide, Urea, Thiourea, and Acetamide; I. Diffuse Penetration from the Enamel Surface. W. W. Wainwright.	770

REPORTS REFERENCE LIST

Report	Title, Author	Abstract
AECU-1031	Beta-Spectrum of As^{77}. Erling N. Jensen, R. T. Nichols, and J. Clement.	885
AECU-1034	The Process of Complex Formation as a Substitution Reaction. (Abstract) Leonard I. Katzin.	774
AECU-1039	Measurements and Resolution Tests of a Spherical Electrostatic Analyzer. C. P. Browne, D. S. Craig, R. M. Williamson, and D. J. Donahue.	850
AECU-1040	Excited States of C^{11} and C^{12}. Virgil R. Johnson.	870
AECU-1041	Elastically Scattered Protons from Carbon. Gerson Goldhaber, R. M. Williamson, H. L. Jackson, and M. J. W. Laubenstein.	876
AECU-1043	The Design and Construction of a Spherical Electrostatic Analyzer. D. S. Craig, C. P. Browne, and R. M. Williamson.	851
AECU-1046	Radiochemical Analysis. Benjamin F. Rider.	780
AECU-1071	Small Angle Scattering of Thermal Neutrons (Theoretical). (Abstract) R. J. Weiss and S. Pasternack.	881
AECU-1117	Studies on Surface Chemistry; Progress Report on Research Project. George Richard Hill, Melvin A. Cook, W. Martin Fassell, Jr., and Ransom B. Parlin.	826
IDD-5	Reference on Therapeutic and Tracer Uses of Radioisotopes; A Bibliography of Useful and Significant Papers in this Field. Isotopes Division, ORE, AEC.	760
K-686	The Construction and Performance of a New Type of Inverted Triode Vacuum Tube Voltmeter. H. S. McKown.	845
KAPL-385	The Complete Solution of the One-Velocity Diffusion Problem at Intermediate and Large Distances. L. Tonks.	867
LA-1135	Proportional Counter Using Argon and Krypton at High Pressures. John Wahl.	852
M-4507	Terminal Report on Filter Paper Analyzer. Nuclear Instrument and Chemical Corp.	853
M-4514	Manual on Radiological Protection for Civilian Defense. Elda E. Anderson, ed.	753
MLM-490	Removal of Submicron Aerosol Particles from a Moving Gas Stream by the Condensation Center Effect. P. J. Schauer.	754
NEPA-1172	Progress Report of NEPA Group at Iowa State College. A. H. Daane, D. J. Kenney, H. W. Maynor, and R. M. Powers.	775
NEPA-1558	Decay Factors for the Computation of Saturated Activity of Indium Foils. R. H. Lewis.	886
NYO-511	Progress Report; AEC Contract AT(30-1)-651. V. K. La Mer, P. R. Gendron, and R. S. Gruen.	755
NYO-576	X-ray Diffraction Studies of Cold Work in Metals; Solid Solutions and Grain Boundaries; Technical Report No. 1, Scope II. B. E. Warren and B. L. Averbach.	827
NYO-596	Progress Report for July 1 - September 30, 1950. F. H. Norton, W. D. Kingery, D. M. Fellows, M. Adams, M. C. McQuarrie, and R. L. Cobble.	820
NYO-1614	Effect of Antibiotics on Mortality from Internal Radiation. Simon Koletsky.	759
ORO-20	Investigation of Materials for Use in a Heat Transfer System Containing Molten Lead Alloys; Progress Report No. 1; June 1, 1950, to July 31, 1950. O. Cutler Shepard.	817

REPORTS REFERENCE LIST

Report	Title, Author	Abstract
RMO-563	Mineralogy of Uranium and Thorium Bearing Minerals. D'Arcy George.	833
TID-371	Tritium (H^3); A Bibliography of Unclassified Literature. Fred E. Croxton and Simone B. Schwind, comps.	903
UCRL-440(Rev.)	Relative High Energy Neutron Yields from Targets Bombarded with Protons and Deuterons. William J. Knox.	877
UCRL-708(Rev.)	High Energy Photo-Nuclear Reactions. Karl Strauch.	878
UCRL-710(Rev.)	The Production of Mesons by Protons on Deuterons. H. P. Noyes.	861
UCRL-770	Auger Effect in Astatine. Lawrence S. Germain.	887
UCRL-908	The Path of Carbon in Photosynthesis; XI. The Role of Glycolic Acid. L. Schou, A. A. Benson, J. A. Bassham, and M. Calvin.	771
UCRL-910	Large Angle Scattering of π^- Mesons. H. Bradner and B. Rankin.	862
UCRL-942	Some Neutron-Deficient Strontium Isotopes. Stanley Vernon Castner.	888
UCRL-946	Long-Lived Bi^{207} and Energy Levels of Pb^{207}. H. M. Neumann and I. Perlman.	889
UCRL-948	Experience at the University of California with the Treatment of Patients with Hyperthyroidism by I^{131}. Earl R. Miller.	761
UCRL-957	Beta Decay Energy of Ac^{228}. K. L. Hall and D. H. Templeton.	890
UR-112	Medical Aspects of Civil Defense Against Atomic Weapons. William F. Bale, George H. Casarett, Donald R. Charles, Adrian Dahl, Joe W. Howland, John B. Hursh, Mary Lou Ingram, Harry J. Kingsley, Alexander Leighton, Ralph J. Low, Alec E. Martin, Herbert Mermagen, Joseph T. Payne, James Scott, J. Newell Stannard, and Luville T. Steadman; J. Newell Stannard, and Henry A. Blair, eds.	756
UR-131	Preparation of Tissue Sections for Examination in the Electron Microscope. Michael L. Watson and Bessie L. Jacobson.	742
UR-135	Problems in the Establishment of Maximum Permissible Radiation Exposure Levels. J. N. Stannard.	757
UR-141	Effect of Aureomycin on Coagulation Time. Frank W. Furth, Joan Shrier, and Joe W. Howland.	743
Y-662	Why Separate Stable Isotopes? C. P. Keim.	846

OTHER UNCLASSIFIED REPORTS OF SPECIAL INTEREST TO AEC LABORATORIES

AD-259(P)	Silver-Bearing Phosphate Glasses as Dosimeters. Raymond S. Alger.	855
AERE-EL/R-457	A Kicksorter of Improved Design. E. H. Cooke-Yarborough, C. D. Florida, J. Bradwell, and G. A. Howells.	854
AERE-G/M-55	A Cloud-Chamber Study of the β-Ray Spectrum of Holmium 166 and Thulium 170. G. F. Snelling and E. W. Titterton.	893
AERE-G/M-69	A.E.R.E. (Harwell) Machines for Nuclear Physics Research. Atomic Energy Research Establishment.	880
AERE-T/R-580	The Representation of an Empirical Function by Means of a Polynomial. D. J. Behrens.	847
BR-223A	Corrosion of Uranium Metal in Air and Steam at Various Temperatures. T. Wathen.	828
BR-306A	Uranyl Fluoride — Miscellaneous Notes; Note No. 31. The Preparation of Anhydrous UF_4 from Small Samples of U_3O_8. G. O. Morris.	815

Report	Title, Author	Abstract
CRL-AE-54	A Study of the Determination of Uranium by Measurement of Fluorescence. S. Jacobs.	784
NACA-TN-2224	Multiple-Film Back-Reflection Camera for Atomic Strain Studies. Anthony B. Marmo.	787
NP-1598	The Determination of Free Acid in Leach Solutions. J. C. Ingles.	782
NP-1769	Tables for β-Decay Systematics. L. W. Nordheim.	898
NP-1785	Statement of Progress for the Month of September, 1950. John A. Clark.	818
NP-1807	The Ejection of the Electron Beam from the Betatron. Sherwood L. Fawcett and E. C. Crittenden, Jr.	879
NP-1823	Fundamental Properties of Metal-Ceramic Mixtures at High Temperatures. W. B. Crandall and W. G. Lawrence.	821
NP-1826	Conference on Radiation Cataracts and Neutron Effects. P. H. Abelson.	746
NP-1832	Occurrence of the Citric Acid Cycle in Tumors. Sidney Weinhouse, Ruth H. Millington, and Charles E. Wenner.	773
NP-1835	Vapor Pressure of Inorganic Substances; III. Chromium between 1283 and 1561°C. Rudolph Speiser, Herrick L. Johnston, and Paul Blackburn.	831
NP-1842	Metabolic Equations for Radio-Iodine Tests. T. H. Oddie.	772
NRL-TRANS-245	On Some Mathematical Methods in the Theory of Scattering of Particles; Part I: Trans. from Zhur. Eksptl. i Teoret. Fiz. 18, 337-45(1948). I. E. Tamm; tr. by A. Pingell.	902
NRL-3657	Infrared Spectra of Phosphorus Compounds. L. W. Daasch and D. C. Smith.	900

GENERAL

ATOMIC BOMBS AND WARFARE

741

"DEATH SAND" IS ATOMIC DANGER. Chemistry 24, No. 2, 9-11(1950) Oct.

A proposal for the use of radioactive poisons in warfare is being studied. Use of the above material is considered difficult for war purposes. The "death sand" is prepared by drying fission product salt solutions on sand or metal powder. It is described as the lightest and most transportable of all the weapons of mass destruction. A highly deadly layer on the surface of the ground would weigh only 12 mg/m^2 and would be quite invisible. Speculations on its production and use are submitted.

BIOLOGY AND MEDICINE

742

University of Rochester Atomic Energy Project
PREPARATION OF TISSUE SECTIONS FOR EXAMINATION IN THE ELECTRON MICROSCOPE. Michael L. Watson and Bessie L. Jacobson. Aug. 10, 1950. 15p. (UR-131)

A method is described for obtaining tissue sections for the electron microscope showing resolution of detail on the order of 100A which appears to be characteristic of the tissue examined. Methods have been developed for methacrylate embedding which allow reliable polymerization of the plastic. It has been shown that it is possible to remove the embedding material from osmic-fixed tissue sections without introducing objectionable distortion. (auth)

743

University of Rochester Atomic Energy Project
EFFECT OF AUREOMYCIN ON COAGULATION TIME. Frank W. Furth, Joan Shrier, and Joe W. Howland. [nd.] 4p. (UR-141)

Therapeutic doses of aureomycin given orally to normal dogs had no effect on the whole blood coagulation time as determined by the Lee White method with blood drawn from the external jugular vein. Intravenous administration produced a marked prolongation in 4 of 7 dogs. Most of the dogs which showed a prolonged coagulation time also exhibited a shocklike state immediately after injection. It was not determined whether this was caused by the aureomycin HCl or the sodium glycinate used as a buffering agent. Mixing of aureomycin with whole blood drawn from the vein had no apparent effect on the coagulation time.

RADIATION EFFECTS

744

Biological Laboratory, Cold Spring Harbor, N. Y.
ALLELISM OF SECOND CHROMOSOME LETHALS IN D. MELANOGASTER. Bruce Wallace. [nd.] 5p. (AECU-990)

Through an analysis of the frequency of allelism of 100-sec chromosome lethals induced in Drosophila melanogaster by chronic γ-ray treatment, it has been estimated that the minimum number of loci capable of mutating to lethality under these conditions is 400 (234-718). (auth)

745

BIOLOGICAL EVALUATION OF 20 MILLION VOLT ROENTGEN RAYS. V. BAR EFFECT IN DROSOPHILA. W. M. Luce, H. Quastler, and E. F. Lanzl. Am. J. Roentgenol. Radium Therapy 64, 963-7(1950) Dec.

The reduction of eye facet number in Drosophila melanogaster after irradiation during the sensitive period was used to compare effects of high- and low-energy roentgen rays. It was found that the efficiency η (20 million volt at 200 kv) = 0.85, the amounts of both radiations being measured by a certain thimble chamber. The result falls in line with values previously obtained with responses to single doses: 0.79 for acute roentgen death in mice, 0.72 for graying of hair in mice, 0.75 for production of sex-linked lethals in Drosophila.

746

Division of Medical Sciences, NRC
CONFERENCE ON RADIATION CATARACTS AND NEUTRON EFFECTS. Philip H. Abelson, chairman. Feb. 17, 1950. 100p. (NP-1826)

A report is given of the above conference, which comprised two parts, (1) a discussion of the production and detection of neutrons and of experimental neutron-irradiation of animals and (2) a discussion of various studies made on the lens of the eye and the effects of radiation thereon. 181 references.

747

THE EFFECT OF IRRADIATION ON THE DENTAL SYSTEM AS DEMONSTRATED BY THE ROENTGENOGRAM. Karl W. Bruce and Edward C. Stafne. J. Am. Dental Assoc. 41, 684-9(1950) Dec.

Five cases in which irradiation affected the dental system are reported. Each patient received irradiation therapy in infancy for a pathologic process occurring in proximity to the developing dentition. Either x ray, surface radium packs, or radon seed implantation were used as the source of irradiation. Dental examination and roentgenograms were made at a time when the complaints of the patient centered attention on the dentition. From the evidence revealed by the roentgenograms, it is assumed that irradiation (1) can injure a tooth germ to the extent that a tooth will not form, (2) causes dwarfing of permanent teeth, (3) effects dwarfing of the roots of permanent teeth that are undergoing development during irradiation, (4) effects premature completion of calcification of permanent teeth, and (5) may cause early eruption of permanent teeth.

748

EXTREME RETARDATION OF EPIPHYSEAL GROWTH FROM ROENTGEN IRRADIATION. A Case Study. Charles H. Frantz. Radiology 55, 720-4(1950) Nov.

The inhibiting and destructive effects of roentgen rays on epiphyseal cartilage are well demonstrated in this case. An infant born with a large "blood tumor," diagnosed as hemangioma hypertrophicum, of the right leg was treated with a series of 400- and 200-r doses of 135-kv x rays. After 15.5 yr, there has resulted a 29% lag in longitudinal growth of the treated leg, which is 9¾ in. shorter than the normal member, although normal knee-joint motion has persisted.

749

PLATELET VALUES IN PERSONNEL ENGAGED IN ROENTGEN DIAGNOSTIC WORK. Harry Mossberg. Acta Radiol. 34, 186-92(1950) Sept.

Among personnel occupied in roentgen diagnostic work the author has found a definite decrease in the platelet count in about one-third of the cases. On account of these findings the author is of the opinion that the platelet count should be used as an integral part of the routine blood control of personnel engaged in radiologic work. (auth)

750

THE PROPERTIES OF X-RAY-INACTIVATED BACTERIOPHAGE. I. INACTIVATION BY DIRECT EFFECT. James Dewey Watson. J. Bact. 60, 697-718(1950) Dec.

The inactivation by x rays of bacteriophages of the T group suspended in broth has been investigated, and the properties of the inactive viruses have been studied. Inactivation is a simple exponential function of the dose, indicating a one-hit inactivating mechanism. All the inactive particles are able to adsorb on sensitive bacteria, but only a fraction of them retain the ability to kill bacteria or to exclude another phage type. The ability to inhibit lysis or to lyse bacteria from without is not lost when the ability to kill bacteria is destroyed. Multiplicity reactivation and photoreactivation of x-ray-inactivated phage are observed in slight amounts. The results have been used to distinguish two stages in the early period of phage reproduction, the first stage being called "adsorption," the second "invasion." (auth)

751

RADIATION INJURY TO PLANTS GROWN IN NUTRIENT SOLUTIONS CONTAINING P^{32}. James M. Blume, C. E. Hagen, and Ruth W. Mackie. Soil Sci. 70, 415-26(1950) Dec.

Experiments are described in which young barley plants were grown in nutrient solutions containing various amounts of P^{32}. The lengths of leaves and the dry weights of tops and roots were used as the criteria of injury caused by the radioactive material. Meristematic regions of the plants were examined histologically, and photomicrographs of normal and of injured root tips and apical buds are shown. It was found that damage to the tops was more severe than damage to the roots, and that the injury was due primarily to radiation from the P^{32} accumulated within the plant, the P^{32} which remained in the nutrient solution having relatively little effect. There was no evidence of damage to cells other than those which were in zones of active division. Absorption of phosphate from solution was not affected by radiation injury. The lowest level at which damage was produced under the experimental conditions employed corresponds to 5.6 mc of P^{32} per gram of P_2O_5. (auth)

RADIATION HAZARDS AND PROTECTION

752

Mound Laboratory
REMOVAL OF SUBMICRON AEROSOL PARTICLES FROM A MOVING GAS STREAM BY THE CONDENSATION CENTER EFFECT. P. J. Schauer. [nd.] Decl. Aug. 2, 1950. 30p. (AECD-2986;MLM-450(Rev.))

In the disposal of radioactive solid wastes from laboratories and plants by incineration, the flue gases may be assumed, in most cases, to contain the radioactivity in the form of particulate matter. The gas volume to be handled is small, probably less than 100 cu ft/min. Efficiences of practically 100% are required. After a survey of known methods of removal of submicron particles from gas streams, a new method using the condensation-center effect was investigated. This method consists in introducing the gas stream into a steam exhauster, the condensing water droplets forming on the particles and growing to such size that they can be removed completely by conventional equipment. Various designs of nozzles were tested, and the value of double condensation effects was shown. A penetration as low as 0.35% was achieved. 12 figures.

753

Oak Ridge National Laboratory
MANUAL ON RADIOLOGICAL PROTECTION FOR CIVILIAN DEFENSE. Elda E. Anderson. Apr. 1950. 173p. (M-4514)

The purpose of this manual is to indicate an approach to the problem of creating an organization to handle one phase of the civilian defense problem, that of radiological defense. A general outline of atomic physics is followed by extensive discussions of radiation units and instruments, biological effects of radiation, atomic bomb phenomena, and defense plans. No particular reader background is assumed. Elementary and technical language is mixed in a manner con-

sidered most expeditious in achieving reasonable coverage of the material in the space available.

754

Mound Laboratory
REMOVAL OF SUBMICRON AEROSOL PARTICLES FROM A MOVING GAS STREAM BY THE CONDENSATION CENTER EFFECT. P. J. Schauer. Sept. 1, 1950. 36p. (MLM-490)

This report is based on report MLM-450(Rev.)(now AECD-2986) an abstract of which appears as NSA 5-752.

755

Columbia University
PROGRESS REPORT;AEC CONTRACT AT(30-1)-651. V. K. La Mer, P. R. Gendron, and R. S. Gruen. Jan. 30, 1950. 11p. (NYO-511)

A study of the filtration characteristics of exceedingly fine aerosols as a function of their particle radius is reported. Previously developed methods have been adopted for use with the standard di-octylphthalate smoke and preliminary results are reported with Whatman No. 2 filter paper and Chemical Corps paper No. 5. The penetrability of the latter paper increases progressively with decreasing droplet radius instead of passing through the customary maximum at about 0.15 μ.

756

University of Rochester
MEDICAL ASPECTS OF CIVIL DEFENSE AGAINST ATOMIC WEAPONS. William F. Bale, George H. Casarett, Donald R. Charles, Adrian Dahl, Joe W. Howland, John B. Hursh, Mary Lou Ingram, Harry J. Kingsley, Alexander Leighton, Ralph J. Low, Alec E. Martin, Herbert Mermagen, Joseph T. Payne, James Scott, J. Newell Stannard, and Luville T. Steadman; J. Newell Stannard and Henry A. Blair, Eds. Sept. 1, 1950. 265p. (UR-112)

Lectures on the following topics are reported: radiation syndrome in man, a proposed operational procedure following a near-surface atomic bomb burst, handling of food and water supplies (to avoid radioactive contamination), radiation detection and measurements, biological effects of radiation, radiation pathology, internal radiation hazards, mechanical and thermal injury from the atomic bomb, medical aspects of atomic disaster control, civil defense in Great Britain, and psychological factors in major disasters.

757

University of Rochester Atomic Energy Project
PROBLEMS IN THE ESTABLISHMENT OF MAXIMUM PERMISSIBLE RADIATION EXPOSURE LEVELS. J. N. Stannard. Dec. 1950. 2p. (UR-135)

The report is reproduced here in its entirety.

A considerable fraction of the cost of any nuclear energy installation results from measures necessary to protect the health of personnel. For the same reason, otherwise simple procedures are frequently rendered clumsy and difficult. Since absolute protection is impossible, maximum permissible levels and times of exposure must be established for situations ranging from the short acute emergency permitted, perhaps, in a military situation or an emergency repair operation to lifetime exposure in a nuclear energy plant and its environs. The background for presently permitted levels will be reviewed with emphasis placed on the "safety factors" introduced at each step to cover gaps in our knowledge. The most extensive data, of course, stem from experience with x rays and radium. For this reason there is a strong tendency to relate the effects of all other ionizing radiations to one or both of these. In some instances the comparison is valid, in others it is subject to considerable error. For example, the biological effectiveness of different types of radiation is not calculable from their relative ionizing power and must be determined experimentally for reasons which are not yet clear. These so-called "biological effectiveness ratios" may differ considerably for different physiological functions. With radioactive materials, differences in distribution and excretion do not seem to be adequately accounted for by comparing the toxicity of a given substance to that of radium. The greatest difficulty arises in the establishing of levels for chronic exposure. In general, even for x rays and radium, actual long-term experiments with suitable test objects is the only satisfactory solution. Such experiments require 5, 10, or more years and ample financial support. Yet the need for working figures is pressing. Hence, there is a tendency to employ several methods of estimation by extrapolating from established facts. Discrepancies are then reconciled by choosing a "best" figure, sometimes as much by intuition as by logic. The importance to the nuclear engineer of an adequate knowledge of these biological problems is clear and is a strong stimulus to active collaboration between health specialists and engineers and physicists at all stages of design and operation.

758

BIOLOGICAL ASPECTS OF ATOMIC ENERGY. Brit. Med. J., 999(1950) Oct. 28.

A brief report is given of some of the information on radiation effects, genetic hazards, control of radiation hazards, and the responsibilities of atomic scientists presented at the Royal Institution, London, October 20-21, 1950.

RADIATION SICKNESS

759

Western Reserve University Atomic Energy Project
EFFECT OF ANTIBIOTICS ON MORTALITY FROM INTERNAL RADIATION. Simon Koletsky. Sept. 28, 1950. 14p. (NYO-1614)

Streptomycin and penicillin in combination proved effective in reducing the mortality of rats given lethal doses of radioactive phosphorus. Morbidity was also reduced and survival time prolonged. (auth)

RADIOTHERAPY

760

Isotopes Division, ORE, AEC
REFERENCE ON THERAPEUTIC AND TRACER USES OF RADIOISOTOPES; A BIBLIOGRAPHY OF USEFUL AND SIGNIFICANT PAPERS IN THIS FIELD. Aug. 15, 1950. 66p. (IDD-5)

References are listed according to therapy, diagnosis, physiological studies, dosimetry, and techniques.

761

University of California Radiation Laboratory
EXPERIENCE AT THE UNIVERSITY OF CALIFORNIA WITH THE TREATMENT OF PATIENTS WITH HYPERTHYROIDISM BY I^{131}. Earl R. Miller. Oct. 1950. 36p. (UCRL-948)

A short history of the clinical use of radioiodine at the University of California Medical School is presented. Data on the first 100 consecutive patients treated with radioactive iodine for hyperthyroidism are summarized. Methods of selection and treatment and the results of such treatment are given. The results of radioiodine therapy for hyperthyroidism are found to compare favorably with the results of other methods of treatment of this syndrome. This applies only to the patient who does not have a nodular goiter. Follow-up studies of patients, up to 4 yr in some cases, have shown a striking absence of recurrence. The number of patients rendered hypothyroid by this treatment is not more, and may be less, than is produced by surgery. No untoward effect of the treatment, except hypothyroidism, has become evident in the follow-up of this group of patients. The place of radioiodine in the therapy of hyperthyroidism is considered.

762

CLINICAL ISODOSE CURVES. R. Loevinger, B. S. Wolf, and W. Minowitz. Am. J. Roentgenol. Radium Therapy 64, 999-1009(1950) Dec.

The nature and extent of deviations from the conventional, central-axis determinations of depth doses, and simplifications of isodose-curve measurements in finite phantoms have been investigated. Isodose curves of 200-kvp x rays at 50-cm focus-skin distance have been determined for infinite, semi-infinite, cylindrical, and neck-shaped water phantoms.

763

DOSAGE UNITS FOR HIGH-ENERGY RADIATION. U. Fano and Lauriston S. Taylor. Radiology 55, 743-7(1950) Nov.

A general discussion of the changing emphasis on various aspects of radiation dosage measurement and the increasing clarification of the problem is presented. Certain tentative agreements regarding the introduction of new units which have been formulated by workers from many countries are listed.

764

INTRACAVITARY VISCERAL RADIATION: EFFECT ON GASTRIC ACID SECRETION. J. B. R. McKendry. Proc. Soc. Exptl. Biol. Med. 75, 25-7(1950) Oct.

An apparatus is described which permits intracavitary radioisotopic irradiation of hollow viscera accessible to intubation. In preliminary trials with I^{131} the technique has been used to induce achlorhydria in the stomach of dogs. This technique may have additional practical applications for treatment of lesions in the rectum, bladder, bronchi, and other organs or tracts accessible to intubation. (auth)

765

LEUKOPLAKIAS OF THE ORAL CAVITY. Alberto Anzilotti. Radiologia Med. 36, 413-20(1950) May. (In Italian)

A survey of clinical and pathogenic features of oral leukoplakia is followed by a comparative study of methods of treatment, viz., excisions, diathermocoagulation, and Curie- and Roentgenotherapies.

766

A NOMOGRAM FOR DOSE DETERMINATIONS IN DIAGNOSTIC ROENTGENOLOGY. Joseph Sorrentino and Rosalyn Yalow. Radiology 55, 748-53(1950) Nov.

Data enabling the radiologist to determine skin dose to the patient for any diagnostic procedure, for x rays from 35 to 105 kv with target-skin distance of 10 to 100 in., is presented. The equality of x-ray output per milliampere-second (mas) for different generators and tubes, operated under the same conditions, was investigated for seven machines. In all cases the r/mas was found to be within ±10% of the average, and to agree with the data in National Bureau of Standards Handbook 41. On the basis of these data, a nomogram was constructed, which makes possible the determination, to within ±25% of the true value, of the dose delivered to the patient for any particular procedure. Use of the nomogram is illustrated by examples.

767

SOME DETAILS IN THE EQUIPMENT OF THE NEW ROENTGEN DEPARTMENT OF THE BISPEBJERG HOSPITAL, COPENHAGEN, DENMARK. Chr. I. Baastrup. Acta Radiol. 34, 177-85(1950) Sept.

A description is given of various contrivances and procedures adopted in the new roentgenological department. Of particular interest is the detailed description of the "Baastrup-Johnsen" ionization-chamber-type roentgen dosimeter, used to measure the therapeutic irradiations.

TOXICOLOGY STUDIES

768

CUTANEOUS BERYLLIUM GRANULOMA. H. Lee Large, Jr. and Alfred R. Stumpe. Southern Med. J. 44, 36-8(1951) Jan.

A case of recurrent beryllium granuloma of the skin following a wound from a broken fluorescent light bulb is reported. The value of histologic examination of cutaneous lesions is indicated. It led in this case to procuring an adequate history, in correlation with which a reasonable diagnosis was established. The necessity of complete surgical excision of local posttraumatic beryllium granulomata is

demonstrated. The futility of attempted eradication of cutaneous lesions associated with pulmonary and systemic beryllosis is mentioned. 13 references. (auth)

TRACER APPLICATIONS

769

Los Alamos Scientific Laboratory
PATHWAYS OF ENAMEL PENETRATION AND TESTS OF IMPREGNATION WITH RADIOACTIVE SALTS OF CALCIUM^{45}, ZINC^{63,65}, SILVER^{110,111}, PLUTONIUM^{239}, PALLADIUM^{103}, IODINE^{131}, AND COPPER^{64}. Wm. Ward Wainwright. [nd.] 34p. (AECU-998;LADC-861)

$Ca^{45}Cl_2$, $Ag^{110,111}NO_3$, $Pd^{103}Cl_2$, NaI^{131}, and $Cu^{64}(NO_3)_2$ were found by radioautographic examination to penetrate enamel defects, lamellae, and carious areas. Intact enamel was not penetrated although there was an uptake on the surface of enamel and cementum which was not removed by washing. $Zn^{63,65}Cl_2$ was precipitated by potassium ferrocyanide on tooth surfaces and was found to penetrate lamellae, carious lesions, fissures, and other defects. Since nearly all the lamellae could be subsequently penetrated by stable $AgNO_3$ they were not considered to be completely plugged. Pu^{239} citrate complex attached itself to the surface of enamel and cementum but did not penetrate defects and carious areas subsequently stained by $AgNO_3$. (auth)

770

Los Alamos Scientific Laboratory
TIME STUDIES OF THE PENETRATION OF EXTRACTED HUMAN TEETH BY RADIOACTIVE NICOTINAMIDE, UREA, THIOUREA, AND ACETAMIDE; I. DIFFUSE PENETRATION FROM THE ENAMEL SURFACE. W. W. Wainwright. [nd.] 26p. (AECU-1000;LADC-862)

Rapid diffuse penetration of grossly intact enamel by isotope-labeled solutions of nicotinamide, urea, thiourea, and acetamide was determined radioautographically in 23 extracted human teeth. Eight of the teeth were formol fixed. No effect of fixation, age, sex, or tooth location was observed. Nicotinamide penetration was the slowest. The earliest diffuse penetration observed was through 0.4 mm of enamel within 79 min. Urea, thiourea, and acetamide penetrated more rapidly. Urea penetrated half the thickness of the enamel (0.5 mm) within 20 min. Thiourea (a toxic substance not suitable for oral use) and acetamide penetrated the entire thickness of the enamel (1.1 and 0.3 mm, resp.) within 34 min. After slightly longer periods all four compounds penetrated the dento-enamel junction at intervals and went into the dentin. In a few teeth the pulp was reached. Chromatographic examination of dentin extracts from two teeth to which C^{14}-urea had been applied to the enamel surface identified the compound which penetrated as the urea molecule. (auth)

771

University of California Radiation Laboratory
THE PATH OF CARBON IN PHOTOSYNTHESIS; XI. THE ROLE OF GLYCOLIC ACID. L. Schou, A. A. Benson, J. A. Bassham, and M. Calvin. Sept. 11, 1950. 18p. (UCRL-908)

The metabolism of C^{14}-labeled glycolic acid by Scenedesmus has been studied using radiochromatographic techniques for the separation and identification of products. When the pH of the medium was 2.8, appreciable assimilation occurred. The products were identical to those observed in $C^{14}O_2$ photosynthesis. A major reaction anaerobically in the dark resulted in incorporation of C^{14} in almost equal amounts in the glycine and serine reservoirs. When the algae were illuminated, a diminution in the amount of glycine was observed. Aerobic and anaerobic glycolic acid assimilation was studied during photosynthesis. The C^{14} level in the sucrose and the intermediates of its synthesis varied with $C^{12}O_2$ pressure in the gas used. 1-C^{14} and 2-C^{14} glycolic acids give similar distribution of radioactivity in the products. Hence, glycolic acid is assimilated by paths other than those involving preliminary cleavage to C_1 compounds. Phosphoglyceric acid isolated from the products of assimilation of both glycolic acids was degraded and found to be approximately equally labeled in its α and β carbon atoms. (auth)

772

Commonwealth X-Ray and Radium Laboratory
METABOLIC EQUATIONS FOR RADIO-IODINE TESTS. T. H. Oddie. July 1950. 14p. (NP-1842;Technical Communication No. 41)

Mathematical relationships, for practical application, are derived from studies of the metabolic functions in conjunction with the introduction of radio-iodine into the blood stream at zero time. The fraction found in the thyroid later can be measured and plotted to give an "uptake" curve. The total fraction excreted, can also be measured and plotted to give an excretion curve. Further mathematical relationships are presented.

773

Lankenau Hospital Research Institute and Temple University
OCCURRENCE OF THE CITRIC ACID CYCLE IN TUMORS. Sidney Weinhouse, Ruth H. Millington, and Charles E. Wenner. 1950. 3p. (NP-1832)

Confirmation of the occurrence of the citric acid cycle in transplanted mouse tumors (a mammary adenocarcinoma, a rhabdomyosarcoma, and a hepatoma) has been obtained by isolating radioactive quinidine citrate as a product of the oxidation of C^{14}-labeled palmitic and acetic acid.

CHEMISTRY

774

Argonne National Laboratory
THE PROCESS OF COMPLEX FORMATION AS A SUBSTITUTION REACTION. Leonard I. Katzin. Nov. 1, 1950. 1p. (AECU-1034;UAC-322)

The report is reproduced here in its entirety.

The literature on solvation, especially hydration, of metal ions in solution has shown conflict between the "indefinite cloud" type of picture, and that in which the solvent is considered coordinated with a definite small-number stoichiometry. Evidence in favor of the latter viewpoint is given in the form of spectrophotometric data on salts in mixed solvent systems, phase equilibrium data for ternary systems, salt-water-organic solvent, and data from studies of the heats of solution of a series of salt hydrates in water and a selected group of organic solvents. The not-novel point is stressed that the process of formation of "complexes" cannot be accurately studied without taking specific account of the solvent, and the competion between the solvent and the other complexing agent or agents for the coordination positions around the metal atom.

775

Iowa State College
PROGRESS REPORT OF NEPA GROUP AT IOWA STATE COLLEGE. A. H. Daane, D. J. Kenney, H. W. Maynor, and R. M. Powers. Oct. 31, 1950. 109p. (NEPA-1172)

Results of an investigation to prepare and to test the stability of a number of compounds containing relatively large amounts of hydrogen, which might be useful in pile shielding have been reported. The first material suggested was tungsten hydride which, if it could be prepared, would have satisfactory neutron shielding properties, being a combination of a good neutron decelerator and a high atomic weight element for radiation shielding. Efforts to prepare this material by several methods were unsuccessful. It was apparently too unstable. The second material to be investigated with regard to its temperature stability was $Ba(OH)_2 \cdot 8H_2O$. This proved to be considerably less stable than the literature value seemed to indicate and readily decomposed to the monohydrate. Work has continued on this latter compound, the vapor pressure being measured at several temperatures by two entirely different methods. A study has been started on the thermal stability of various hydrated materials. This work has evolved mainly into the study of such systems as $Ba(OH)_2 + H_2O$, $KOH + H_2O$, and $Ba(OH)_2 + KOH + H_2O$. Physical chemistry studies of materials, made up as metal thermocouples and oxide thermocouples to be used at elevated temperatures, are reported.

776

CHEMICAL OXIDATION OF ORGANIC ACIDS. I. SOME OBSERVATIONS ON THE OXIDATION OF PROPIONATE BY ALKALINE PERMANGANATE. Henry R. Mahler and Ammarette Roberts. J. Am. Chem. Soc. 72, 5095-8(1950) Nov.

Comparison of results obtained for the alkaline permanganate oxidation of propionate-1-C^{14} with those for the corresponding C^{11} compound show certain differences: 90% of the activity is incorporated in the oxalate fraction in the former case compared to 87% for the latter. Since these differences may be within the limits of experimental error, their significance is hard to assess. Thus the presence of a measurable isotope effect in this case could not be definitely determined. Since pyruvate has been postulated as an intermediate in propionate oxidation, the behavior of pyruvate-2-C^{14} in alkaline permanganate was investigated. Under these conditions approximately 80% of the pyruvate is transformed into oxalate and carbonate, with the former retaining all the activity; 20% of the pyruvate is decarboxylated, however, yielding labeled acetate and inactive carbonate. Thus, decarboxylation is a minor pathway in pyruvate oxidation under these conditions and has to be taken into consideration when discussing the mechanism of propionate oxidation as well. (auth)

777

GEOCHEMISTRY. Kalervo Rankama and Th. G. Sahama. Chicago, University of Chicago Press, 1950. 911p.

Remarkable for its scope and detail, this volume relates the most recent nuclear and chemical knowledge to the broad field of geochemistry. Beginning with an extensive explanation of the relative abundances of elements and nuclides, approximately half the volume is devoted to the chemistry of the lithosphere, hydrosphere, atmosphere, and biosphere, the present composition and cyclic processes of which are related to ionization potentials, crystallography, ion exchange, selective accumulation of elements by plants, etc. Under the subject of cosmochemistry the composition of comets and meteors, planetary interiors and atmospheres, and interstellar matter are discussed. Part II considers each element of the periodic table individually with respect to its abundance, geochemical character, ores, and biogeochemistry. The occurrence in nature of the "missing" elements (Tc, Pm, At, and Fr), the short-lived members of natural radioactive series, and the transuranium elements through Cm is considered. Over 700 references are included in the extensive bibliography.

778

VANADIUM OXIDES. A. Yu. Polyakov and A. M. Samarin. Uspekhi Khim. 19, 565-75(1950) Sept.-Oct. (In Russian).

In a critical survey of the present state of knowledge of vanadium oxides, it is pointed out that experimental data on phase equilibria in the system vanadium-oxygen and on dissociation characteristics of vanadium oxides are still incomplete and inaccurate. On the other hand, several thermodynamic properties of V and its oxides (heat capacities, entropies, heats of formation) have been determined with sufficient ampleness to permit calculations of physicochemical relationships (free-energy changes, dissociation pressures) with better accuracy than that offered by direct

measurements. As a consequence, the latter may lead to false conclusions, such as, e.g., an erroneous attribution to V (in oxidation to V_2O_3) of a higher affinity for O than that exhibited by Si. Among the literature cited (mostly non-Russian) is one of the co-author's work on vapor pressure of V_2O_5 in the temperature interval 700 to 1200°C (Polyakov, Zhur. Fiz. Khim. 20, 1021 (1946)).

ANALYTICAL PROCEDURES

779

Oak Ridge National Laboratory
ACTIVATION ANALYSIS BY MEANS OF THE OAK RIDGE REACTOR. G. W. Leddicotte and S. A. Reynolds. [nd.] 8p. (AECD-2992)

Radioactivation analysis is unique because of its freedom from interference by other elements. The danger of contamination often encountered in conventional analyses is negligible, and great sensitivity may be obtained for many elements. The method is described, and a list of sensitivities in μg of various elements for activation by the neutron flux normally obtained in the Oak Ridge reactor is given.

780

Knolls Atomic Power Laboratory
RADIOCHEMICAL ANALYSIS. Benjamin F. Rider. [nd.] 22p. (AECU-1046)

A general introduction to the use of radioisotopes in chemical analysis is presented. Analytical methods, measurement of α, β, and γ radiations, and applications are discussed briefly.

781

DETECTION OF TRACES OF RARE ELEMENTS WITH THE AID OF LUMINESCENCE ANALYSIS. H. Haberlandt. Oesterr. Chem. Ztg. 51, 102 (1950) June. (Note; in German)

Detection, and often a quantitative evaluation, of traces of various elements, e.g., rare earths, can be made by observing characteristic luminescences in filtered ultraviolet light. The consideration of the influence of admixtures is important: thus, the presence of Fe weakens the luminescence, Pb furthers it, while Mo modifies the spectrum. The best results are obtained either by using borax- or NaF-beads, or by a preliminary chromatographic separation on aluminum oxide.

782

Department of Mines and Technical Surveys, Mines Branch, Ottawa
THE DETERMINATION OF FREE ACID IN LEACH SOLUTIONS. J. C. Ingles. Mar. 18, 1950. 13p. (NP-1598;Topical Report No. 42)

During the course of current experiments on the leaching of ores, it was found that direct pH measurements did not provide a satisfactory indication of the actual acidity of the solutions. Direct titration of the free-acid content of the liquors used in ore-leaching was not possible because of the high concentration of hydrolyzable salts present in them. Experiments on addition of the neutral-complex-forming reagent potassium oxalate to remove the interfering Fe and Al before titration with KOH solution indicated that this is a satisfactory procedure. Experiments with potassium fluoride had to be discontinued because of HF attack on the glass electrode used. It is possible that an Sb electrode could be used, in which case the fluoride would probably be more suitable than the oxalate. 11 figures.

783

ON THE THERMOGRAVIMETRY OF ANALYTICAL PRECIPITATES. XL. DETERMINATION OF VANADIUM. Clément Duval and André Morette. Anal. Chim. Acta 4, 490-7(1950) Oct. (In French)

The authors have traced the pyrolysis curves of those precipitates which have been used for the gravimetric determination of vanadium, and have examined the methods critically. The following reagents were rejected: sulfide, benzoic acid (or cinnamic acid), barium chloride in alkaline medium, silver nitrate in alkaline medium, manganous sulfate, α-nitroso-β-naphthol, oxine, and dicyandiamide. The best methods employ mercurous nitrate, cupferron, strychnine, and luteocobaltic chloride (the latter in alkaline or neutral medium). For the automatic determination of vanadium, only three methods were retained: cupferron, luteocobaltic chloride in alkaline medium, and strychnine. (auth)

784

Chemical Research Laboratory, Teddington
A STUDY OF THE DETERMINATION OF URANIUM BY MEASUREMENT OF FLUORESCENCE. S. Jacobs. Apr. 1950. 33p. (CRL-AE-54)

The fluorometric determination of uranium has been made on samples containing the element in quantities varying between 10 and 0.01 μg. The samples analyzed by this method included eluates from cellulose paper strips and cellulose columns, extracts from phosphate ores treated with ether-sulfuric acid mixtures, and leach solutions from certain ores. This paper describes the method of fusion for each of several fluxes used. A simple baffle with fixed aperture makes possible the examination of samples containing 10 μg without causing fatigue in the electron multiplier photocell. The uniform fusion process for multiple samples was facilitated by the use of an in-line jet gas burner. A study has been made of the quenching of the fluorescence of uranium, also of the anomalous enhancement of the fluorescence of uranium in alkali metal carbonate fluxes containing sodium fluoride. A critical examination of the fluorescence spectra of uranium-NaF phosphors containing other elements has been made. The results of this study suggest an explanation for the anomalous enhancement of the fluorescence in terms of the spectral response curve of the photocell and the transmission curve of the optical filter used in the fluorometer. (auth)

785

USE OF ULTRAVIOLET RAYS FOR THE CHROMATOGRAPHIC ANALYSIS IN AN ADSORPTION COLUMN. E. M. Brumberg, I. N. Berezhnaya, V. P. Dutkinskiĭ, and S. E. Manoĭlov. Doklady Akad. Nauk S.S.S.R. 74, 747-50(1950) Oct. 1. (In Russian)

Several procedures are described utilizing the invention of Brumberg (Doklady Akad. Nauk S.S.S.R. 72, 885(1950) June 11; NSA abstract 4-6650), in which products of chromatographic separation are detected and identified according to their various absorptions of ultraviolet light. Whereas in the previous work the construction of multiple fluorescent filters and their applications in filter-paper chromatography were described, the present article deals with the use of chromatographic columns, as illustrated by the separation of products of protein hydrolysis.

ATOMIC WEIGHTS AND PERIODIC SYSTEMS

786

A NEW FORM OF MENDELEYEV'S PERIODIC TABLE OF ELEMENTS REFLECTING KNOWN DATA ON THE STRUCTURE OF ATOMS. V. L. Al'banskiĭ. Doklady Akad. Nauk S.S.S.R. 75, 209-11(1950)Nov. 11. (In Russian)

A periodic table of elements is presented that aims at a combination of the usual arrangement, as given by Mendeleyev, with some clear indications reflecting the electronic structure of the atom. The main feature is the placing of the sub-groups under headings S,P,D,F, which indicate the place occupied by the last electron, either in the outer shell (headings S or P), or in the preceding ones (D or F). Thus, the first and the second groups each have two sub-groups, S and D (the latter comprising Cu-Ag and Zn-Cd); the third group has three sub-groups, D, F, and P (the sub-group F comprising the lanthanides and the actinides); and the remaining groups are composed of sub-groups D and P. The property of some of the rare earths and of some of the actinides of presenting valences higher than 3, because of alternative electronic configurations, is also indicated.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

787

Lewis Flight Propulsion Laboratory
MULTIPLE-FILM BACK-REFLECTION CAMERA FOR ATOMIC STRAIN STUDIES. Anothony B. Marmo. Nov. 1950. 22p. (NACA-TN-2224)

A new back-reflection x-ray diffraction technique, which eliminates some of the principal limitations and reduces the remaining limitations imposed by conventional single-film back-reflection methods, was developed through use of a multiple-film camera containing four parallel films separated by known distances. Diffraction angles were calculated by determining the change in radius of the diffraction ring from film to film. In the analysis of a polycrystalline aggregate, the atomic spacing of a particular set of crystal planes in essentially one orientation is determined from the calculated diffraction angle. Diffuse diffraction patterns could be analyzed by the multiple-film technique with greater accuracy than could be obtained with conventional cameras. Calibration of the multiple-film camera with a gold powder standard for a set of planes having a reported atomic spacing of 0.91008 A yielded a possible accuracy of the atomic spacing of approximately $\pm 4 \times 10^{-5}$ A. A multiple-film-technique analysis and a conventional-method analysis of the same x-ray strain data indicated that a more detailed analysis of atomic strain could be obtained from the multiple-film technique. 8 figures. (auth)

788

THE CRYSTAL STRUCTURE OF THORIUM TETRABROMIDE. R. W. M. D'Eye. J. Chem. Soc., 2764-6(1950) Oct.

The crystal structure of thorium tetrabromide has been determined by means of x-ray powder diffraction photographs. The structure is body-centered tetragonal, space group $D_{4h}^{19} - I4/amd$, with a, c, c/a, and ρ (calc.) equal to 8.945 A, 7.930 ± 0.005 A, 0.887, and 5.69 g/cc, respectively. There are 4 molecules per unit cell. Positions have been found for the atoms such that the calculated are in good agreement with the observed intensities. The Th-Br nearest neighbor distance is 2.57 A, and the Th-Br second nearest neighbor distance is 3.31 A. It would appear that the bromide, like the chloride, is partially covalent in character. The arrangement of the four nearest bromine atoms around the thorium atom is shown to be a distorted square or an extremely flattened tetrahedron with Br-Th-Br angles of 93.8 and 150.2 deg. (auth)

DEUTERIUM AND DEUTERIUM COMPOUNDS

789

DETERMINATION OF IMPURITY TRACES. MASS SPECTROMETRIC METHOD. R. E. Honig. Anal. Chem. 22, 1474-6(1950) Dec.

A method for the mass-spectrometric determination of impurity traces is described, which is applicable to cases where the impurity pattern is masked by the main compound. The method utilizes ionizing energies in the ionization and appearance potential range. Results are presented for some deuterated hydrocarbons and for 2-methyl propane. (auth)

FLUORINE AND FLUORINE COMPOUNDS

790

THE ACTION OF ELEMENTARY FLUORINE UPON ORGANIC COMPOUNDS. XV. FLUORINE AND COBALTIC FLUORIDE AS FLUORINATING AGENTS FOR KETONES. Fred F. Holub and Lucius A. Bigelow. J. Am. Chem. Soc. 72, 4879-84(1950) Nov.

Acetone, methyl ethyl ketone, and diethyl ketone have been fluorinated by cobaltic fluoride in a modified Fowler apparatus. The ketones were completely cleaved under the mildest conditions used, and it has been shown that acetone was split, in part at least, before any substitution had occurred. In contrast, methyl ethyl ketone has been fluorinated by elementary fluorine, in a recently modified unit which is described in detail. Under these conditions the perfluoroketone $CF_3COCF_2CF_3$ was formed in significant yield, together with smaller amounts of the corresponding heptafluoro- and hexafluoroketones (isomeric mixtures), as well as a number of cleavage products, including CF_4, C_2F_6, and CF_3COF. The observed total cleavage by the milder re-

agent, and only partial fragmentation by the more vigorous reagent, has been attributed to the formation of transitional complex compounds between the ketones and the cobaltic fluoride, which would be expected to promote cleavage. Presumably such complexes would not be formed when elementary fluorine was used. Certain related work has also been described, including the formation of perfluorocyclopentanone by the direct method, and the conversion of some fluoroethanes into one another in good yields by cobaltic fluoride. (auth)

791

COMPOUNDS DERIVED FROM 3-HALO-1,1,1-TRIFLUOROPROPANE. E. T. McBee, Alec E. Kelley, and Edward Rapkin. J. Am. Chem. Soc. 72, 5071-3(1950) Nov.

From the 3,3,3-trifluoropropyl Grignard reagent several new compounds have been prepared, including methyl and ethyl esters of 4,4,4-trifluorobutyric acid, 4,4,4-trifluorobutyraldehyde, 5,5,5-trifluoro-2-pentanol, 1,1,1,5,5,5-hexafluoro-2-pentanone and its hydrate, and 1,1,1,7,7,7-hexafluoro-4-heptanone. Some of the compounds thus prepared have been used to synthesize 4,4,4-trifluoro-1-butanol, 4-iodo-1,1,1-trifluoropentane, and 5,5-bis-(3′,3′,3′-trifluoropropyl)-hydantoin. 3-Iodo-1,1,1-trifluoropropane has been prepared. (auth)

792

ELECTRIC MOMENTS OF ORGANOSILICON COMPOUNDS. I. FLUORIDES AND CHLORIDES. Columba Curran, Robert M. Witucki, and Patrick A. McCusker. J. Am. Chem. Soc. 72, 4471-4(1950) Oct.

Electric moments have been determined for the three ethylchlorosilanes, the three phenylchlorosilanes, the three phenylfluorosilanes, and for triethylfluorosilane and diethyldifluorosilane. A comparison of the moments of the ethylhalosilanes with the values for the chlorosilanes reveals that the ethyl group is much more positive with respect to silicon than is hydrogen. This is interpreted as a hyperconjugation effect. Replacement of an ethyl by a phenyl group results in an increase in moment for all compounds studied. The alkyl- and phenylsilyl groups are more polarizable than are the corresponding hydrocarbon radicals. (auth)

793

ESTERS OF MONOFLUOROPHOSPHORIC ACID. Archie Hood and Willy Lange. J. Am. Chem. Soc. 72, 4956-8(1950) Nov.

The reaction of anhydrous hydrogen fluoride with polyphosphoric acid esters has been studied as a means of preparing esters of monofluorphosphoric acid, $(HO)_2POF$. In this reaction the P-O-P bridges of the polyphosphate chain are split in rapid succession, from one end of the chain to the other, by molecules of hydrogen fluoride, with a fluorine atom becoming attached, in each step, to the phosphorus atom which is split from the end of the chain. Two types of esters of monofluorophosphoric acid have been prepared: (a) the known neutral esters, $(RO)_2POF$, and (b) the hitherto unreported acidic half-esters, (RO)(HO)POF, and their alkali salts. In contrast to the neutral esters, salts of the acidic half-esters, i.e., of monoalkyl monofluorophosphates, showed very little toxicity and practically no anti-cholinesterase activity. The alkali salts were effective in preventing the growth of certain molds on solid agar media. (auth)

794

ORGANIC FLUORIDES. IV. FLUORINATION OF HYDROAROMATIC HYDROCARBONS BY USE OF A GOLD CATALYST. R. N. Haszeldine and F. Smith. J. Chem. Soc., 2787-9(1950) Oct.

Vapor-phase fluorination using a gold catalyst gives better yields of fluorocarbons from hydroaromatic hydrocarbons than from the parent aromatic hydrocarbons. Ethylcyclohexane was found to be the best hydrocarbon for the preparation of a C_8F_{16} fluorocarbon. The fluorination of 1,3-dimethylcyclohexane, 1,3,5-trimethylcyclohexane, tetrahydronaphthalene, and decahydronaphthalene was also accomplished.

795

ORGANIC FLUORIDES. III. FLUORINATION OF AROMATIC HYDROCARBONS BY USE OF A GOLD CATALYST. R. N. Haszeldine and F. Smith. J. Chem. Soc., 2689-94 (1950) Oct.

The action of fluorine on aromatic hydrocarbons in the vapor phase in the presence of a gold catalyst and an inert gas produces fluorocarbons. The latter contain only carbon and fluorine and are believed to possess the same carbon skeleton as the parent hydrocarbon. Perfluorocyclohexane was readily obtained from benzene at 280°C. Perfluoromethylcyclohexane was produced by fluorination of toluene or benzotrifluoride at 250°C. Fluorocarbons of the formula C_9F_{18} were obtained by fluorination of technical xylene, o-xylene, m-xylene, bistrifluoromethylbenzene, and ethylbenzene. Mesitylene proved to be a convenient substance for the production of C_9F_{18}, but it suffered more decomposition than either xylene or toluene. ψ-Cumene, less symmetrical and presumably less stable than mesitylene during fluorination, gave a poor yield of C_9F_{18}.

796

THE REACTIONS OF FLUOROCARBON RADICALS. III. THE SYNTHESIS OF HEPTAFLUORO-BUTYRIC ACID. R. N. Haszeldine. J. Chem. Soc., 2789-92(1950) Oct.

The interaction of heptafluoroiodopropane and acetylene yields 3,3,4,4,5,5,5-heptafluoro-1-iodopent-1-ene, which, on treatment with permanganate, gives heptafluorobutyric acid. Salts and derivatives of the acid are described, and the synthesis of long-chain fluoro and fluorohalogeno acids is discussed. (auth)

797

SOLVOLYSIS BY BROMINE TRIFLUORIDE. A. G. Sharpe. J. Chem. Soc., 2907-8(1950) Oct. (Notes)

Attempts to make metal fluorotitanates by the reaction in nonaqueous solution of the BrF_3-system acids and bases led to the formation of products heavily contaminated with bromine. The reversibility of the reaction $2KBrF_4 + (BrF_2)_2TiF_6 \rightleftharpoons K_2TiF_6 + 4BrF_3$ has now been demonstrated by showing that combination of acid and base is incomplete and that BrF_3 causes partial decomposition of pure potassium fluorotitanate. These effects presumably explain the

general occurrence of bromine impurity in the product from reactions of this type.

RADIATION CHEMISTRY

798

STANDARDIZATION OF I^{131} SOLUTIONS BY DIRECT COMPARISON OF GAMMA ACTIVITIES. William A. Reilly, Dina I. Bayer, and Jack M. Siegel. Proc. Soc. Exptl. Biol. Med. 75, 1-3(1950) Oct.

A rapid and convenient method for the standardization of I^{131} solutions for clinical use by direct comparison of the γ-ray intensity with that of a standard solution is described. A statistical evaluation of the method showed that the standard deviation of the mean for 10 samples was approximately 1%. (auth)

RADIATION EFFECTS

799

CHEMICAL ACTIONS OF IONISING RADIATIONS IN SOLUTION. VI. RADIATION CHEMISTRY OF STEROLS. THE ACTION OF X-RAYS ON CHOLESTEROL AND 3β-HYDROXY-PREGN-5-EN-20-ONE. Max Keller and Joseph Weiss. J. Chem. Soc., 2709-14(1950) Oct.

In continuation of previous work on the chemical action of ionizing radiations and the formation of free radicals and atoms in these processes, the action of x rays on cholesterol and 3β-hydroxypregn-5-en-20-one in aqueous systems has been investigated. From the irradiated solutions it was possible to isolate and to characterize by unambiguous methods cholestane-3β,5α,6β-triol and 3β-hydroxycholest-5-ene-7-one from the former, and 3β,5α,6β-trihydroxyallopregnane-20-one from the latter. These substances are formed in relatively good yields and account for 80 to 90% of the starting materials. The outline of a mechanism of the formation of these compounds is given on the basis of general theory, and some possible biological implications of these findings are briefly discussed.

800

CHEMICAL ACTIONS OF IONISING RADIATIONS ON AQUEOUS SOLUTIONS. V. HYDROXYLATION OF NITROBENZENE BY FREE RADICALS PRODUCED BY X-RAYS. H. Loebl, Gabriel Stein, and Joseph Weiss. J. Chem. Soc., 2704-09(1950) Oct.

Following the quantitative investigation of the hydroxylation of nitrobenzene by free hydroxyl radicals produced by the hydrogen peroxide-ferrous salt reagent (J. Chem. Soc., 2074(1949)), further investigations now show that the action of x rays on dilute aqueous solutions of nitrobenzene leads to the same products. The ratio of the o-, m-, and p-isomers is essentially the same as in the previous case, thus confirming again the assumption of free-radical formation by ionizing radiations. The use of this method allows the employment of more refined analytical techniques and the study of the effect of pH on the relative ratio of the various products. It is shown that the position occupied by the nitro group is also attacked, resulting in a denitration with the formation of nitric acid. The quantitative results are in agreement with a reaction mechanism involving two distinct steps. (auth)

SEPARATION PROCEDURES

801

ANALYTICAL APPLICATIONS OF ION EXCHANGE SEPARATIONS. Jack Schubert. Anal. Chem. 22, 1359-68(1950) Nov.

The fundamental principles underlying the analytical applications of ion exchange are reviewed. Several applications of the ion-exchange technique are given, including the removal of interfering substances, separation of cations from anions, purification of isotopes and inorganic and biological substances, determination of trace impurities, measurement of the stability of complex ions, determination of activity coefficient, and evaluation of molecular structure. Specific applications are cited. 82 references.

802

CHROMATOGRAPHIC TECHNOLOGY IN RADIOISOTOPE SEPARATION. PART II. APPLICATIONS. Herbert Weil. Atomics (London) 1, 345-56(1950) Dec.

Chromatographic separations of the rare earths by ion exchange, adsorption, and partition are discussed. Chromatographic separation of artificial elements such as berkelium and of elements occurring in nature, including references to work with actinium, protactinium, thorium, and uranium, are reported. It is indicated that chromatographic separation of an elemental isotope which has been produced as a fission product is possible whereas separation of an isotope obtained by bombardment in a reactor (where the parent is the same element as the isotope daughter) is impractical. Radioactivity as an aid in the study and use of chromatography is discussed. 120 references.

803

ION EXCHANGE SEPARATIONS. Edward R. Tompkins. Anal. Chem. 22, 1352-9(1950) Nov.

The properties and laboratory applications of some commercially available ion exchangers, as well as current theories concerning the mechanism of the separation of substances by ion exchange are reviewed. A brief description of laboratory procedures for equilibrium experiments and for column separations is given. Several theories designed to predict column separations are evaluated. Results of a number of column separations of substances with similar properties are reviewed. 92 references.

804

RATIONALE OF ANALYTICAL SEPARATIONS BY SIMPLE IMMISCIBLE SOLVENT EXTRACTION. E. B. Sandell. Anal. Chim. Acta 4, 504-12(1950) Oct.

Expressions are given for the calculation of recovery and separation factors from extraction coefficients in immiscible solvent separations. Extraction coefficients of separation

forms in inorganic analysis are usually variables which are a function of reagent concentration and acidity, and whose value can be derived from the equilibrium constant of the extraction reaction. (auth)

805

STUDIES ON THERMODIFFUSION IN THE LIQUID PHASE. I. Prigogine, L. de Brouckère, and R. Amand. Physica 16, 577-98(1950) July-Aug. (In French)

Experiments on thermodiffusion of binary organic solutions by the thermogravitational method are described. The separation curves are discussed in connection with the "effet oublié." For nearly perfect solutions, the Soret coefficient D'/D is independent of the composition. The sign of D'/D is determined by the difference in the cohesion densities (energy of vaporization/molar volume) of the pure constituents. The constituent with higher density of cohesion is enriched at the cold wall. A derivation of this rule based on the elementary theory of transport phenomena in the liquid phase is given. (auth)

SORPTION PHENOMENA

806

ON THE PHASES OF SUBSTANCES IN THE ADSORPTIVE LAYER. I. E. Neĭmark and F. I. Khatset. Doklady Akad. Nauk S.S.S.R. 74, 751-4(1950) Oct. 1. (In Russian)

Many authors hold that capillary condensation is involved in every adsorption from vapors. The problem is approached here by adsorbing a binary mixture from vapor in equilibrium with a liquid phase, and comparing the composition of the absorbed mixture with that of both phases; thus, if the adsorbed substance has the composition of the liquid, its state in the adsorptive layer is a liquid phase, etc. Mixtures $C_6H_6 + CCl_4$ and $C_6H_6 + C_7H_{16}$ were used in experiments involving silica gel samples of various sizes of pores. While in coarsely porous gels the adsorbed substance is liquid, in finely porous ones it is a vapor, and in intermediate types the two phases are present. Another series of tests dealt with adsorbers with partially filled adsorptive surfaces. The adsorption begins with a vapor phase, the liquid phase appearing after a certain filling has been reached; the value of that threshold filling grows with the diameter of the pores.

SPECTROSCOPY

807

THE RAMAN AND INFRARED SPECTRA OF PERFLUOROPROPANE. Walter F. Edgell, H. Dean Mallory, and Donovan G. Weiblen. J. Am. Chem. Soc. 72, 4856-9(1950) Nov.

The Raman spectrum of C_3F_8 has been obtained in the liquid state at $-65°C$. The infrared spectrum has been obtained at 25°C and at pressures ranging from 1.5 to 500 mm. Although it is not now possible to make an accurate assignment of the observed frequencies, it is believed that 22 of the 27 fundamentals have been located. (auth)

808

SPECTROCHEMICAL DETERMINATION OF IRON; MAGNESIUM, AND MANGANESE IN TITANIUM METAL. Maurice J. Peterson. Anal. Chem. 22, 1398-1400(1950) Nov.

A spectrochemical method for the determination of iron, manganese, and magnesium in titanium metal is described in which a sulfuric acid solution of the metal is placed in a porous-cup electrode, and excitation accomplished by means of a controlled Multisource unit. Average deviations from chemical values are approximately ±8% for both Fe and Mg in the concentration ranges 0.08 to 0.5% and 0.02 to 0.2%, respectively. Average deviation for Mg is ±6% in the concentration range of 0.05 to 0.7%. The method has been found useful for testing sample lots. (auth)

SYNTHESES

809

THE PREPARATION OF DEMEROL-N-METHYL-C^{14} BY REDUCTIVE METHYLATION. Winifred Tarpey, H. Hauptmann, B. M. Tolbert, and H. Rapoport. J. Am. Chem. Soc. 72, 5126-7(1950) Nov.

Demerol-N-methyl-C^{14} has been synthesized using the formate-formaldehyde reductive methylation method. By the use of labeled formaldehyde in one reaction and labeled formic acid in another it has been shown that in this reaction the formaldehyde is the source of the N-methyl group, that the only major source of the reductive action is formic acid going to carbon dioxide, and that there is no exchange between the formic acid and formaldehyde. (auth)

810

PREPARATION OF DEUTERATED STEROIDS. David K. Fukushima, Seymour Lieberman, and Bernadette Praetz. J. Am. Chem. Soc. 72, 5205-11(1950) Nov.

Two methods for the introduction of stably bound deuterium into the steroid nucleus have been investigated. One method consisted in the bromination of Δ^5-unsaturated steroids with N-bromosuccinimide followed by catalytic replacement of the 7-bromo group of the product with deuterium. The deuterium atom in 7-d-Δ^5-steroids prepared in this manner was shown to be stably bound. The other procedure involved the desulfurization of suitable steroid mercaptols with "deuterized" Raney nickel, affording d_2-steroids. The mercaptols used in this study were readily prepared from Δ^5-7-ketosteroids by condensation with ethanedithiol in the presence of anhydrous zinc chloride. The ultraviolet spectra of the ethylene mercaptols have been determined, and the contribution of the dithiolane ring estimated. (auth)

TRACER APPLICATIONS

811

APPLICATIONS OF RADIOACTIVE TRACERS. A. G. Moddock. Mon. farm. y terap. (Madrid) 56, 337-41(1950) Sept. 20. (In Spanish)

Techniques of using radioactive tracers are discussed, including those procedures which use relatively small amounts of radioactive materials, based on five principal groups: (1) experiments which utilize the great sensitivity of methods of detection and determination of radioactive substances, (2) applications in which the radioactivity of the tracer atoms makes it possible to distinguish groups of atoms of the same chemical identity, (3) experiments in which the quantity of one substance is determined by the lowering of specific activity after mixing with a radioactive form of the same substance, (4) procedures for showing the location of radioactive substances which depend on the penetrating properties of the radiations, and (5) the measure of time for the disintegration of radioactive materials. 31 references.

URANIUM AND URANIUM COMPOUNDS

812

Argonne National Laboratory
THE REACTION OF UF_4 WITH DRY O_2; A NEW SYNTHESIS OF UF_6. S. Fried and N. R. Davidson. May 1945. Decl. Aug. 18, 1950. 10p. (AECD-2981;ANL-WMM-633)

Uranium tetrafluoride, UF_4, reacts with dry O_2 at 800°C according to the reaction: $2UF_4 + O_2 \rightarrow UF_6 + UO_2F_2$. At 350°C there is no rapid reaction. The reaction is a new method of synthesis for UF_6, not requiring the use of elementary fluorine. When the reaction was carried out in a nickel tube, the yield of UF_6 varied between 16 and 40% of theoretical. The UO_2F_2 appeared to be somewhat volatile at 800°C and to sublime out of the platinum boat used to contain the UF_4. From these data it appears that the success of the common analytical procedure of igniting UF_4 to U_3O_8 without loss at about 800°C is due to hydrolytic conversion of the fluoride to oxide by moisture. Calculations of the free energy changes for the reactions

$$2UF_4 + O_2 \rightarrow UF_6 + UO_2F_2,$$
$$3UO_2F_2 \rightarrow UF_6 + \tfrac{2}{3}U_3O_8 + \tfrac{1}{3}O_2,$$
$$UF_4 + O_2 \rightarrow UO_2F_2 + F_2,$$
$$UF_4 + \tfrac{1}{3}O_2 \rightarrow \tfrac{1}{3}U_3O_8 + 2F_2,$$
$$UF_4 + H_2O + \tfrac{1}{2}O_2 \rightarrow UO_2F_2 + 2HF,$$
$$UO_2F_2 + H_2O \rightarrow \tfrac{1}{3}U_3O_8 + 2HF + \tfrac{1}{6}O_2$$

as a function of temperature are presented. (auth)

813

Argonne National Laboratory
THE TRINITRATOURANYL COMPLEX IN KETONIC SOLVENTS. L. Kaplan, R. A. Hildebrandt, and M. Ader. Oct. 1, 1950. Decl. Dec. 6, 1950. 28p. (AECD-3015; ANL-4520)

The formation of a stable trinitratouranyl anion, $UO_2(NO_3)_3^-$, in acetone and methyl isobutyl ketone solutions has been demonstrated spectrophotometrically as well as by studies of solubility, electrolytic transference, and partition between solvents. This complex is responsible for the enhancement of uranyl nitrate extraction into methyl isobutyl ketone by hydrazine, high-molecular-weight amines, and quaternary ammonium salts. The stability of the anionic complex has been found to depend on the nature of the associated cation and to decrease with increasing water content of the solvent. The existence of a stable anionic thorium nitrate complex has been inferred from the effect of thorium nitrate on the spectra of uranyl nitrate solutions, and from the increased extraction of thorium nitrate into methyl isobutyl ketone in the presence of solvent-soluble nitrate salts. (auth)

814

Iowa State College
SOME PROBLEMS IN THE CHEMISTRY OF URANIUM AND THORIUM OF INTEREST TO THE DEVELOPMENT OF ATOMIC POWER. Robert William Nottorf. 1945. Decl. Oct. 13, 1950. 149p. (AECD-2984)

Detailed results of certain investigations performed during the early days of the atomic energy program are presented. A procedure is given for the determination of Ba and Sr activities in U fission product material which also provides for the recovery of the other fission products. The vapor pressure of UBr_4 was determined by the transpiration method over the temperature range 450 to 650°C. Heats of sublimation, fusion, and vaporization of UBr_4 were calculated. Physical studies of the hydrides of thorium and uranium included determinations of the dissociation pressures of the $U\text{-}UH_3\text{-}H_2$ system, volume of the $U\text{-}UH_3$ and $U\text{-}UD_3$ systems, fractionation of H_2 and D_2, dissociation pressures of the $Th\text{-}H_2$ system, and the existence and heats of formation of two Th-H compounds.

815

Imperial Chemical Industries, Ltd., Widnes
URANYL FLUORIDE — MISCELLANEOUS NOTES; NOTE NO. 31. THE PREPARATION OF ANHYDROUS UF_4 FROM SMALL SAMPLES OF U_3O_8. G. O. Morris. Nov. 8, 1949. 3p. (BR-306A; BDDA-191;R/GC/986/31)

Samples of U_3O_8 of the order of 1 g in weight can be converted to anhydrous UF_4 by the "dryway" process. This process consists in dissolving the U_3O_8 in HNO_3, decomposing the UO_2NO_3 to UO_3 in a furnace, passing a current of H_2 at 650°C over the UO_3 to produce UO_2, cooling the reactor to 450°C, and passing a current of HF gas in excess for 2.0 hr. Two special samples of U_3O_8 have been successfully converted to UF_4. The U recoveries were 96.45 and 98.1%, respectively.

816

MAGNETIC SUSCEPTIBILITIES OF URANIA-THORIA SOLID SOLUTIONS. W. Trzebiatowski and P. W. Selwood. J. Am. Chem. Soc. 72, 4504-06(1950) Oct.

The magnetic moment of tetravalent uranium has been determined in solid solutions of uranium dioxide with diamagnetic thorium dioxide in the concentration range 100 to 2% urania. The molar susceptibility of the uranium rises sharply with increasing magnetic dilution, but this is caused almost entirely by a diminution of the Weiss constant. The magnetic moment of the uranium shows little, if any, dependence on concentration. The moment at the greatest dilution is in agreement with the "spin only" formula for two unpaired electrons, and hence with the 6d rather than the 5f electron distribution. (auth)

ENGINEERING

HEAT TRANSFER

817

Stanford University School of Mineral Sciences
INVESTIGATION OF MATERIALS FOR USE IN A HEAT TRANSFER SYSTEM CONTAINING MOLTEN LEAD ALLOYS; PROGRESS REPORT NO. 1; JUNE 1, 1950, TO JULY 31, 1950. O. Cutler Shepard. July 31, 1950. 8p. (ORO-20; Report No. VIII)

Progress is reported briefly on investigations of the solubility of pure iron in pure lead at various temperatures, wetting of metals by liquid lead and bismuth, unstressed corrosion tests, and revision of stress-rupture apparatus for operation at higher temperatures. 4 figures.

818

M.I.T. Department of Mechanical Engineering
STATEMENT OF PROGRESS FOR THE MONTH OF SEPTEMBER, 1950. John A. Clark. Oct. 1, 1950. 4p. (NP-1785)

Brief statements are made concerning the effect of pressure on the boiling process in heat transfer.

VACUUM SYSTEMS

819

DEVELOPMENT AND APPLICATION OF HIGH VACUUM TECHNIQUE. M. Pirani. Research 3, 540-7(1950) Dec.

The discussion covers historical development, production of high vacua, measurement of low pressures, application of high-vacuum technique, vacuum deposition, molecular distillation, melting of metals under vacuum, and dehydration. 47 references.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

820

M.I.T. Department of Metallurgy
PROGRESS REPORT FOR JULY 1 - SEPTEMBER 30, 1950. F. H. Norton, W. D. Kingery, D. M. Fellows, M. Adams, M. C. McQuarrie, and R. L. Coble. Sept. 31, 1950. 9p. (NYO-596)

Conductivities of two magnesia and one stabilized zirconia specimens have been determined. The preparation (including thermal history) was identical for the two magnesia specimens. Standard porosity measurements were made. Work has been proceeding on the design and construction of the vacuum furnace in which high-temperature measurements of conductivity will be made. The furnace itself consists of a silica tube about 6 in. in inside diameter and about 2 ft long. One end of this tube will be attached to a diffusion pump by means of an elbow and the other end will be covered with a clear quartz plate through which observations will be made with the optical pyrometer using a system of quartz prisms for sighting.

821

Alfred University
FUNDAMENTAL PROPERTIES OF METAL-CERAMIC MIXTURES AT HIGH TEMPERATURES. W. B. Crandall and W. G. Lawrence. Nov. 30, 1950. 10p. (NP-1823; Periodic Status Report No. 23)

A hot-pressing device was constructed and a technique was developed whereby specimens with low porosities could be prepared rapidly. Two- and three-component systems were among those prepared by this method. A disk-type specimen was incorporated in the oxidation weight-gain studies for the purpose of maintaining constant oxidation areas for longer periods of time. Oxide-layer specimens of low porosity were prepared. Quantitative x-ray analyses were made on these specimens and correlated with water absorption data to obtain the relationship between open and closed pores. A method for characterizing thermal-shock resistance was developed, based on the assumption that failure occurs when any of the thermal stresses becomes greater than the strength of the test body. A hypothesis was developed that includes oxidation, diffusion, and heat-conduction phenomena as variations of the same problem which is based upon the effect of two opposing diffusion processes. (auth)

822

PORCELAINS WITHIN THE BERYLLIA FIELD OF THE SYSTEM BERYLLIA-ALUMINA-ZIRCONIA. Stewart M. Lang, Laurel H. Maxwell, and Milton D. Burdick. J. Research Natl. Bur. Standards 45, 366-73(1950) Nov.

The general physical properties of practically impervious porcelains within the BeO field of the system BeO-Al_2O_3-ZrO_2, whose base compositions approximate that of NBS Body No. 4811C, were found to be as follows: maturing range, 1500 to 1600°C; apparent density 2.9 to 3.4 g/cm³; shrinkage, 17.8 to 20.5%; room-temperature compressive strength, 238,000 to 305,000 psi; room-temperature transverse strength, 17,200 to 34,100 psi; room-temperature transverse strength after thermal shocking, 17,800 to 31,900 psi; transverse strength at 1800°F (982°C), 15,100 to 25,100 psi; approximate Young's modulus at 1800°F, 28,000,000 to 38,000,000 psi; relative thermal shock resistance good; and Knoop hardness numbers (500-g load),

550 to 830. An admixture of 2 wt % of CaO to the base compositions of these porcelains (without which the specimens would not mature to an impervious structure) caused the appearance of unidentified isotropic phases. (auth)

823

THERMAL PROPERTIES OF THE COMPOUND BPO_4. F. A. Hummel and T. A. Kupinski. J. Am. Chem. Soc. 72, 5318-19(1950) Nov. (Note)

The thermal stability and expansion of BPO_4 have been studied. This binary compound is of ceramic interest since it is far more refractory than either B_2O_3 or P_2O_5, is related to the high cristobalite form of silica crystallographically, and shows reluctance to form a glass. Boron phosphate begins to vaporize in the neighborhood of 1450°C and will disappear completely at 1462°C if held for 1 hr at this temperature. With use of microscopic and x-ray methods on the partly vaporized sample quenched from 1452°C, no free P_2O_5, B_2O_3, or H_3BO_3 was detected, indicating that the compound probably does not decompose into the component oxides. Thermal expansion data were obtained with a fused-silica-type dilatometer. The coefficient of thermal expansion of sintered BPO_4 is 90×10^{-7} cm/cm/°C in the range 25 to 1000°C.

GEOLOGY AND GEOPHYSICS

824

THE EARTH'S AGE. Arthur Holmes. Umschau 50, 585-7 (1950) Oct. 1. (In German)

An outline is made of methods for estimating the age of minerals, rock formations, and the earth's crust, based on the determination of the Pb isotope contents. Henderson's measurements of the radii of pleochroic halos, by demonstrating the constancy of radioactive characteristics through ages, proved the reliability of the method. The measurement of four content ratios Pb^{206}/U, Pb^{207}/U, Pb^{208}/U, and Pb^{207}/Pb^{206} in a given mineral furnishes as many independent values of its age, corroborating each other or accounting for possible changes, such as Rn losses and various geochemical and geophysical vicissitudes. In this way the minimum age of 2 billion years could be assigned to the earth's crust, through an analysis of the oldest known uraniferrous rock, a pegmatite from Manitoba; while an estimate of the maximum age, 5.4 billion years, was made by Nier by assuming that all Pb^{207} contained in a certain tertiary ore, 25 million years old, was formed during the earth's history. The most probable mean value, 3.35 billion years, was obtained by Nier from a distribution curve of 1200 values calculated by extrapolating content ratios in 25 Pb ore samples, of various geologic age, taken in pairs.

METALS AND METALLURGY

825

Battelle Memorial Institute
THE DEVELOPMENT OF ALUMINUM–6 PER CENT MAGNESIUM WROUGHT ALLOYS FOR ELEVATED-TEMPERATURE SERVICE. K. Grube and L. W. Eastwood. July 15, 1950. Decl. Nov. 10, 1950. 28p. (AECD-3003; BMI-T-38 (Section I))

An investigation was undertaken to improve the properties of wrought Al–6% Mg alloys at 600°F. Although the 6% Mg binary alloy has very poor resistance to creep, it has been found that the addition of 0.5% Cr and approximately 0.10% Ti produces an alloy which, after stabilization at 600°F prior to test, has higher tensile properties at room temperature and at 600°F than 24S. Its resistance to creep at 600°F, 2500 psi load, is about equivalent to that of 24S Al alloy. In addition, the Al–6% Mg–0.5% Cr–0.10% Ti alloy has low density and probably good resistance to corrosion in ordinary environments. (auth)

826

University of Utah
STUDIES ON SURFACE CHEMISTRY; PROGRESS REPORT ON RESEARCH PROJECT. George Richard Hill, Melvin A. Cook, W. Martin Fassell, Jr., and Ransom B. Parlin. Nov. 27, 1950. 30p. (AECU-1117)

Information on work in progress on the following problems is presented in some detail: the primary corrosion process in cobalt, nickel, and iron and their alloys; oxidation of metals at high temperatures and high pressures; and theoretical investigation of the nature of contact catalytic surfaces and processes in the catalytic hydrogenation of propylene. 16 figures.

827

Massachusetts Institute of Technology
X-RAY DIFFRACTION STUDIES OF COLD WORK IN METALS; SOLID SOLUTIONS AND GRAIN BOUNDARIES; TECHNICAL REPORT NO. 1, SCOPE II. B. E. Warren and B. L. Averbach. July 26, 1950. 17p. (NYO-576; Technical Report No. 1)

The dependence of measured broadening upon λ and θ indicates that cold-work broadening is due primarily to distortion rather than fragmentation. The integrated intensities of the high-order reflections are not decreased by cold work. The effect is quite different from that of temperature vibration, and the term "frozen heat motion" is an incorrect description of cold-work distortion. Modern techniques allow measuring precisely the shape of a reflection rather than just the width. A new method of Fourier analysis has been developed to get as much information as is possible from the x-ray data without making any a priori assumptions about the nature of cold-work distortion. For cold-worked (70-30) α brass filings the x-ray data indicate that the strains in any direction are inversely as the values of Young's modulus for that direction and hence that stress is roughly isotropic. Stress distribution functions are obtained using all the powder pattern lines. The root-mean-square averaged stress decreases with the distance of averaging, indicating the nonuniform nature of the stresses and strains in cold-worked metal. A rough calculation of stored elastic energy for α brass gives 1.4 cal/g. (auth)

828

Imperial Chemical Industries, Ltd.
CORROSION OF URANIUM METAL IN AIR AND STEAM AT

VARIOUS TEMPERATURES. T. Wathen. May 13, 1943. 10p. (BR-223A; R/GC/1304)

The corrosion of U metal in both air and steam has been determined at various temperatures up to 500°C. Penetrations increase with temperature and reach the high figures of 543 mm/yr in air and 7360 mm/yr in steam at 400°C. The percentages of different oxides formed in air at 20 to 500°C and in steam at 150 to 400°C are listed.

829

MICRORADIOGRAPHIC STUDY OF THE CONTOURS OF GRAINS OF PURE ALUMINUM AND OF ALUMINUM-ZINC SOLID SOLUTION DURING INCIPIENT FUSION. Aurel Berghézan, Paul Lacombe, and Georges Chaudron. Compt. rend. 231, 576-8(1950) Sept. 18. (In French)

That the metal constituting the grain boundaries of 99.99% Al has a lower melting point than the mass of the crystal has been shown previously. This phenomenon now has been investigated by the technique of microradiometallography. Near fusion the grain boundary appears as a succession of hollow channels perpendicular to the free surface of the sample, probably because of stress variations in the transition region. In the case of the Al-Zn solid solution, the alloy begins to fuse equally with the grain contours, and a reversible enrichment in zinc of the boundaries is shown. The reasons for this behavior are discussed, and some comments on "burn" and heat-treatment of alloys are made.

830

USAF TESTS TITANIUM IN AIRPLANE STRUCTURALS. Steel 127, No. 22, 61(1950) Nov.

The following topics are briefly discussed: an all titanium alloy wing, comparison of titanium alloy properties with those of alloys presently in use, the Kroll production process, the iodide production process, and powder metallurgy.

831

Ohio State University Cryogenic Laboratory
VAPOR PRESSURE OF INORGANIC SUBSTANCES; III. CHROMIUM BETWEEN 1283 and 1561°K. Rudolph Speiser, Herrick L. Johnston, and Paul Blackburn. July 20, 1950. 13p. (NP-1835)

The vapor pressure of chromium has been measured over the temperature range 1283 to 1561°K by determining the rate at which the metal surface evaporates into a vacuum. The ΔH_0° values have been calculated from the individual vapor-pressure points and show no appreciable temperature trend, the average value being 93.50 ± 0.18 kcal. By combining this value of ΔH_0° with Kelley's free energy functions for solid and gaseous chromium, the vapor-pressure equation $\log P_{atm} = (-20{,}473/T) - 7467$ is obtained. Like the other transition elements of similar crystal structure, with unfilled d shells, chromium has a relatively high energy of sublimation. (auth)

MINERALS AND MINERALOGY

832

Carbide and Carbon Chemicals Corp., Y-12
PROGRESS REPORT ON CARNOTITE STUDIES; CARBONATE PROCESS; RESEARCH AND DEVELOPMENT DIVISION. K. B. Brown, C. F. Coleman, and C. D. Susano. June 1949. Decl. Oct. 9, 1950. 30p. (AECD-2955; Y-441)

Work on the Carbonate (Monticello) Process. Further studies have been made of (1) the build-up of uranium and vanadium in a recycling sodium carbonate leach of calcines from the salt roast and (2) the solubility of certain uranium compounds in solution systems of Na_2CO_3, NaCl, and $NaVO_3$.

The Recovery of Uranium and Vanadium from Carbonate Liquors. Precipitation tests have been continued with synthetic solutions and with actual leach liquors. The satisfactory precipitations of yellow cake with low vanadium concentrations, previously reported, were supplemented by tests of solutions low in uranium and in both uranium and vanadium. No difficulties attributable to the low concentrations were encountered. In the red-cake precipitation studies, preparation of time-concentration curves was continued. The results show the initial rates varying with the concentrations and the curves approaching each other closely after several hours. No critical concentration or abrupt change in the effectiveness of the precipitation was found. A brief study is being made of possible vanadium recovery by reduction and hydrolytic precipitation.

Analytical Services. Improvements in the gravimetric and spectrophotometric determination of sodium and in the colorimetric and gravimetric determination of aluminum in carnotite are reported briefly.

833

Raw Materials Operations Office
MINERALOGY OF URANIUM AND THORIUM BEARING MINERALS. D'Arcy George. Jan. 1949. 198p. (RMO-563)

The report is in two parts. Section I is devoted to a summary of the distribution, chemistry, tests, mode of occurrence and classification of the minerals, and is based in part upon laboratory investigations and in part upon literature studies and field reports. Section II is devoted to descriptions of the individual minerals.

834

COMPOSITION OF SOME AUSTRALIAN MONAZITES. A. W. Wylie. Australian J. Applied Sci. 1, No. 2, 164-71 (1950) June.

The composition of some Australian monazites has been determined by spectrophotometric analysis and compared with that of monazite from other localities. The results show that natural fractionation processes cause only small variations in the relative abundance of the lighter lanthanons ("cerium-group" elements), which abundance falls within the range (total 100) La_2O_3, 21 to 30; Ce_2O_3, 43 to 48; Pr_2O_3, 4.8 to 6.1; Nd_2O_3, 18 to 24; Sm_2O_3, 3.7 to 5.0. An approximate method is described of correcting for contamination of the heavier lanthanons ("yttrium-group" elements) with the lighter lanthanons in the fractional precipitation of the lanthanons with sodium sulfate. (auth)

835

STUDIES OF URANIUM MINERALS (VI): WALPURGITE. Howard T. Evans, Jr. Am. Mineral. 35, 1021-27(1950) Nov.-Dec.

Walpurgite, a hydrated bismuth uranium arsenate from Schneeberg, Saxony, has been studied by x-ray diffraction using the Buerger precession method. The lattice is triclinic with the following elements: $a_0 = 7.13$ A, $b_0 = 10.44$ A, $c_0 = 5.49$ A, $\alpha = 101° 40'$, $\beta = 110° 49'$, $\gamma = 88° 17'$; a:b:c: = 0.683:1:0.525. The crystals are commonly elongated parallel to (001), flattened parallel to (010) and twinned on (010). Morphological data of Weisbach and Fischer are correlated with the x-ray data through the following transformations: Weisbach to x ray $\bar{x}0\bar{1}/0\bar{x}1/001$ (x undetermined); Fischer to x ray $0\bar{1}\bar{1}/302/001$. From the volume of the unit cell as determined by x rays, it is concluded that available data on composition and density are unreliable because of the scarcity of pure material. The best formula is one proposed by Fischer: $2Bi_2O_3 \cdot UO_3 \cdot As_2O_5 \cdot 3H_2O$. (auth)

PHYSICS

836

THE CHERENKOV RADIATION. C. von Fragstein. Umschau 50, 588-90(1950) Oct. 1. (In German)

An elementary explanation is given of the Cherenkov effect, based on an analogy with waves produced in air by a projectile moving with a velocity exceeding that of sound. A device, suggested by Getting (Phys. Rev. 71, 123(1947)) for the use of Cherenkov's effect in a counter that would permit the determination of velocities and masses of mesons, has not yet been successfully realized; however, Dicke (Phys. Rev. 71, 737(1947)) applied Getting's principle to the counting of electrons generated in a ⅛-in. Pb layer by x rays from a 20-Mev betatron.

837

A PHENOMENOLOGICAL THERMODYNAMIC THEORY OF THERMODIFFUSION. Rolf Haase. Z. Physik 127, 1-10 (1949). (In German)

Using a phenomenological thermodynamic procedure, Meixner (Ann. Physik 39, 333(1941); 43, 244(1943)) has determined certain relationships that govern heat and diffusion currents in any binary mixtures of liquids and gases. These relationships are employed here for the derivation of equations describing the thermodiffusion effect in real gases and liquids. First, certain fundamental inequalities and the explicit interdependence of heat conductivities in a mixture are discussed. Then, with the aid of an appropriate state equation and of adequate assumptions concerning the phenomenological coefficients, an approximate calculation is made of the pressure dependence of the thermodiffusion factor in gases. The results are compared with high-pressure experiments (1 to 80 atm) on gas mixtures H_2/N_2, H_2/CO_2, and N_2/CO_2 made by Becker and Schulzeff (Naturwissenschaften 35, 219(1948)). The general agreement is satisfactory in regard to both the pressure and the concentration dependences of the thermodiffusion factor. It follows that the greater part of the pressure effect is due to deviations of thermodynamic functions involved from corresponding values for mixtures of ideal gases, and that the effect can be predicted if the state equation of a given mixture is known. A similar calculation of the pressure effect from the state equation can be made for isotope mixtures. (auth)

ASTROPHYSICS

838

THE PROBLEM OF THE EVOLUTION OF STARS IN OPEN CLUSTERS. A. G. Masevich. Doklady Akad. Nauk S.S.S.R. 75, 173-6(1950) Nov. 11. (In Russian)

The general trend of Russel's diagram relating luminosities of stars of the Main Sequence with their spectral types has been explained by Fesenkov's theory of continuous loss of mass through corpuscular emission during the stellar evolution, the energy being supplied by the cyclic carbon reaction. The luminosity, mass, and radius of a star at a given moment are given as a function of the relative proportions of H, He, and a mixture of heavy elements in the star's composition (Fesenkov, Astron. Zhur. 26, 2,67(1949); see also Masevich, Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 13, 621(1949) and NSA 4-3459). However, the known considerable dispersion of Russel's diagram (± 0.5 stellar magnitude) suggests a superposition of various types of evolution corresponding to original differences in chemical composition of stars born in different parts of our galaxy. This hypothesis is very satisfactorily supported by assuming different heavy-element contents. A further confirmation of this view can be looked for among open star clusters which are recognized as systems of stars having a common origin. An analysis of diagrams (luminosity versus spectral type) of 14 open clusters showed that all differences between curves were accounted for by plausible variations in the heavy-element concentration. Thus, in the cluster Coma Berenices this concentration is 0.14, while in h Perseid it is 0.40. On the basis of these data the theory assigns an age between 1.74×10^9 and 5.97×10^9 yr to the former cluster, where stars of spectral types A0 to G7 are represented, and between 1.01×10^9 and 1.0×10^9 yr to the latter object, with stars B2 to A0.

839

THE SUN DOES NOT HAVE ANY NOTICEABLE PERMANENT MAGNETIC FIELD. Martin A. Pomerantz. Umschau 50, 601-3(1950) Oct. 1. (In German)

The state of the problem of the sun's magnetic field is outlined in connection with the author's investigations. It was the study of the latitude effect of cosmic radiation that

seemed to prove its existence. Since, according to recent views, the radiation consists of nuclei only, with no electron component, the questions concerning the latitude effect and the sun's magnetic field are reopened. In a series of free-balloon experiments on the latitude and altitude effects of the cosmic radiation, the existence of a sharp lower limit in the energy spectrum was not confirmed; nor were any daily variations observed. Thus, no evidence for the existence of the sun's magnetic field was obtained; if it exists, its dipole moment cannot exceed 6×10^{32} gauss/cm^3. However, a hypothesis of a variable field is still plausible; such fields have been observed by Babcock (Phys. Rev. 74, 489(1948)) in several stars.

ELECTRICAL DISCHARGE

840

THE VELOCITY OF PROPAGATION OF THE DISCHARGE IN GEIGER-MÜLLER COUNTERS. H. Saltzmann and C. G. Montgomery. Rev. Sci. Instruments 21, 548-9(1950) June.

The velocity of propagation of the discharge in a Geiger-Mueller counter has been measured in a counter with a divided cathode by the method of delayed coincidences. The parameters varied were the counter potential and the percentage of ethyl alcohol mixed with argon. The results are compared with Wilkinson's theory. Good agreement is obtained except at high velocities where the theory predicts values much too low. (auth)

ELECTRONS

841

NOTE ON THE FOCUSING OF ELECTRON BEAMS IN CERTAIN MAGNETIC FIELDS. P. A. Sturrock. Proc. Phys. Soc. (London) 63B, 954-7(1950) Nov. 1.

Equations are set out which determine the focusing properties of electron beams in magnetic fields whose scalar potential has a plane of antisymmetry. From these is derived the condition that a proposed ray axis and associated focusing requirements should be physically realizable. It is also shown that the fringe effect of fields with sharply defined boundaries may be characterized by a pair of focal lengths for which formulas are given. (auth)

842

SECONDARY ELECTRON EMISSION FROM MOLYBDENUM PRODUCED BY HELIUM, NEON, ARGON, AND HYDROGEN. D. Greene. Proc. Phys. Soc. (London) 63B, 876-89(1950) Nov. 1.

Experiments have been carried out on the secondary electron emission produced at very low pressure from a degassed metal surface by neutral particles resulting from the neutralization of positive ions of about 1000 ev energy in a metal canal. The gases used were helium, neon, argon, and hydrogen. For the first three the energy distribution of the secondary electrons is compatible with the view that a large part of the emission is due to communication of the energy of excitation of a metastable atom to a metallic electron. With hydrogen there is evidence that a similar process occurs with normally excited states of the atom or molecule. In all cases there is evidence that some emission occurs through local heating or disruption of the metal lattice by the mechanical impact of swift atoms, the extent of this increasing from helium and neon to argon and hydrogen. Some reflection of the swift atoms occurs from the metal target. (auth)

GASES

843

THE TEMPERATURE DEPENDENCE OF THE SELF-DIFFUSION COEFFICIENTS OF ARGON, NEON, NITROGEN, OXYGEN, CARBON DIOXIDE, AND METHANE. Edward B. Winn. Phys. Rev. 80, 1024-7(1950) Dec. 15.

The self-diffusion coefficients of A, Ne, N_2, O_2, CO_2, and CH_4 have been measured as functions of the temperature: A, Ne, N_2, and O_2, in the range -196 to 80°C, CO_2 in the range -78.5 to 80°C, and CH_4 in the range -183 to 80°C. The experimental figures have been compared with values calculated on the assumption that the molecular interaction potential is of the form:

$$V(r) = 4\epsilon[-(r_0/r)^6 + (r_0/r)^{12}]$$

With the exception of the lowest point for methane, all figures are in essential agreement with theory. (auth)

INSTRUMENTS

844

Carbide and Carbon Chemicals Corp.
NOTE ON CONSTANT CURRENT REGULATORS. E. E. Minett, D. A. MacRae, and J. Townsend. June 15, 1950. Decl. Oct. 1, 1948. 2p. (AECD-2982)

The report is reproduced here in its entirety.

Numerous measurement and instrument problems require the establishment of a source of constant direct current. Current-regulating circuits have been described in the literature (e.g., Nier, Rev. Sci. Instruments 18, 402(1947), Figure 5) which are variations of the standard electronic voltage regulator. In the case of a constant-current regulator, the controlling voltage is the difference between the potential drop across the load, or across a series resistor in the current-output line, and a reference voltage derived from a gas regulator "VR" tube. This type of circuit works well in principle. However, in practice it is frequently difficult to obtain a potential drop-current relationship in the series resistor or load which will not change with time as the resistor heats up. The essential difficulty arises from the fact that the dropping resistor must carry the full regulated output current. Considerable wattage must be dissipated if large currents are to be handled and when a substantial voltage drop is desired. If ordinary wire-wound resistors are used, it is found that ambient temperature control must be provided, even with resistance wire which has a low temperature coefficient. This is inconvenient and frequently expensive. In the course of improving the current regulation in a mass-spectrometer magnet supply, it has been found advantageous to use an incandescent lamp filament as the dropping resistor. The filament is operated at incandescence, so that the heat losses are very largely radiative and independent, within a few parts in 10,000, of normal variations in room temperature. Because of the

low heat capacity of the filament, equilibrium is reached within several seconds. Owing to their nonlinear voltage-current characteristic, for a given change of current, tungsten lamps furnish approximately twice as much signal voltage to the regulating tubes as do linear resistors operating at the same voltage and current. It has been found possible to regulate a 250-ma current to 2 to 3 parts in 10,000 over periods of many hours, using a 25-watt inside-frosted gas-filled tungsten Mazda lamp as series resistor, a VR-90 to provide the reference voltage, a 6SJ7 as control tube and parallel 807's as series regulator tubes.

845

Carbide and Carbon Chemicals Division, K-25
THE CONSTRUCTION AND PERFORMANCE OF A NEW TYPE OF INVERTED TRIODE VACUUM TUBE VOLTMETER. H. S. McKown. Nov. 2, 1950. 14p. (K-686)

Two high-impedance precision vacuum-tube voltmeters using the inverted triode principle of Yuan have been constructed and tested. The operating range of one is 0 to 400 volts and of the other 200 to 5000 volts. They are based on a null method in which the grid circuit of the tube is in one arm of a bridge. The other arm is a source of constant current. The voltage being measured, which is applied to the plate, is then proportional to the change of resistance required to balance the bridge. The input impedance of both meters is of the order of 10^{10} ohms. Their accuracy when used as direct-reading instruments is better than $\pm 1.5\%$ of the voltage being measured. For more precise measurements a calibration curve is used. (auth)

ISOTOPES

846

Oak Ridge National Laboratory, Y-12 Area
WHY SEPARATE STABLE ISOTOPES? C. P. Keim. Sept. 25, 1950. 18p. (Y-662)

This is a popular presentation of the nature of stable isotopes, of the background of the AEC stable-isotope program, and of many important applications of stable isotopes.

MATHEMATICS

847

Atomic Energy Research Establishment
THE REPRESENTATION OF AN EMPIRICAL FUNCTION BY MEANS OF A POLYNOMIAL. D. J. Behrens. Nov. 1950. 26p. (AERE-T/R-580)

If the values of a function are given at n equally spaced intervals of the argument, a polynomial of order $n-1$ can be found which corresponds exactly to the given values. In general, a polynomial of order $r(<n-1)$ cannot be made to do this, and $S_r(f)$, the minimized sum of the squares of the deviations, will exceed 0. It is shown how $S_r(f)$, and the leading coefficient of the polynomial in question, can be evaluated without having to solve any simultaneous equations. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

848

University of Chicago Metallurgical Laboratory
THE DESIGN AND CONSTRUCTION OF BORON COATED THERMOPILES FOR USE IN NEUTRON FIELDS. Glenn Barbaras, John Farr, John Kuranz, Robert J. Moon, Leonard M. Rieser, George W. Schaeffer, and Thomas Wartek. Feb. 7, 1945. Decl. June 2, 1950. 35p. (AECD-2975;CP-2697)

The introduction to this report deals with the differential thermocouple, its application to the detection of neutrons, and many of its specialized uses. Apparatus for deposition of boron from diborane including a high-vacuum manifold, storage bulb, deposition chamber, exhaust manifold, and filament-heating circuit are described. Procedures are detailed and general precautions are indicated. Photographs and drawings are included.

849

University of Chicago Metallurgical Laboratory
REPORT ON A DIFFERENTIAL IONIZATION CHAMBER. James W. Broxon. July 15, 1943. Decl. Dec. 18, 1950. 16p. (AECD-3014; CT-782)

A chamber was constructed with three electrodes dividing the space into two regions of 800 cc. The surfaces of one of these were coated with boron carbide. With opposite potentials on two electrodes, ion currents to the collecting electrode due to γ rays were practically canceled and ion currents due to α rays induced by slow neutrons were measured. By use of a d-c amplifier, neutron-induced currents of the order of 10^{-12} amp were measured. Locating the chamber in the shield of the pile at Argonne permitted detection of pile intensity when operating at 0.1 w. By changing the potential, it was found that 350 to 400 volts sufficed to provide practical saturation currents of the order of 2 μa measured with a galvanometer. With -360 volts across the uncoated region and 1035 volts across the boron-coated region, an experiment with the pile intensity rising exponentially showed that practical saturation currents in the chamber were certainly provided at 9 or 10 μa, and perhaps at 18 μa. The measurements with the differential chamber in this experiment indicated that the highest intensity of the pile attained in the experiment was approximately 450 kw, while the quadratic relation employed in connection with the BF_3 chamber regularly used for control of the pile indicated 850 kw. An experiment with Cu foils indicated that 1 μa neutron-induced ionization current through the chamber corresponded approximately to $nv = 8 \times 10^7$ neutrons/cm^2/ sec. (auth)

850

University of Wisconsin
MEASUREMENTS AND RESOLUTION TESTS OF A SPHERICAL ELECTROSTATIC ANALYZER. C. P. Browne, D. S. Craig, R. M. Williamson, and D. J. Donahue. [nd.] 1p. (AECU-1039)

The report is reproduced here in its entirety.

Dimensional measurements and operational tests have been made on the spherical analyzer described in the preceding

paper [AECU-1043;NSA 5-851]. The figure of the plates has been determined and the spherical gap mapped. The assembled analyzer has been tested for alignment, focus, and resolution using elastically scattered protons of 0.5- to 1-Mev energy. Monoergic protons scattered from thin targets are focused by the analyzer. A plot of the number of particles entering the detector versus the voltage across the spherical gap gives the resolution. A shutter allows small sectors of the total gap to be tested individually. A sharp focus is obtained, and all sectors focus particles of the same energy for a given gap voltage. Preliminary results indicate a resolution of 500 with 1-mm object and image apertures.

851

University of Wisconsin
THE DESIGN AND CONSTRUCTION OF A SPHERICAL ELECTROSTATIC ANALYZER. D. S. Craig, C. P. Browne, and R. M. Williamson. [nd.] 1p. (AECU-1043)

The report is reproduced here in its entirety.

A spherical electrostatic analyzer has been constructed for use with the Wisconsin cylindrical analyzer (Warren et al., Rev. Sci. Instruments 18, 559(1946)) for accurate measurements of Q values. The focusing properties of such an instrument have been described by Purcell (Phys. Rev. 54, 818(1938)). This instrument permits the use of a large solid angle, approximately 4.4×10^{-3} steradian for a target 1 mm in diameter, while at the same time having a high resolving power. The calculated resolution is 1000 for 1-mm object and image apertures. The plates, constructed of meehanite cast iron, are only a portion of an entire sphere, being 90 deg of the sphere along the path of the particles and having a 60-deg aperture. The mean radius of the plates is 45.95 cm, the gap 0.48 cm. The analyzer has been designed to fit over the cylindrical analyzer and to accept particles at an angle of 135 deg from the bombarding beam. The voltage between the plates required to focus a singly charged particle of energy E is E/47.86 volts.

852

Los Alamos Scientific Laboratory
PROPORTIONAL COUNTER USING ARGON AND KRYPTON AT HIGH PRESSURES. John Wahl. Aug. 1, 1950. 38p. (LA-1135)

One objection to using gas at high pressure is that various undesirable effects, such as negative ion formation and slowness of ion or electron collection, may be accentuated. An investigation to examine the operation of a proportional counter, using various gases and mixtures at high pressures, and to determine how important these undesirable effects are is reported.

853

Nuclear Instrument and Chemical Corp.
TERMINAL REPORT ON FILTER PAPER ANALYZER. May 31, 1950. 15p. (M-4507)

An air proportional counter and associated electronic circuit has been described which is relatively independent of atmospheric humidity conditions. This has been accomplished by the use of specially designed Teflon insulators to support the counter center wires and a cast nylon film. In addition, a nonfrequency discriminating pulse-height selector was designed for use in the instrument. (auth)

854

Atomic Energy Research Establishment
A KICKSORTER OF IMPROVED DESIGN. E. H. Cooke-Yarborough, C. D. Florida, J. Bradwell, and G. A. Howells. Dec. 1949. 47p. (AERE-EL/R-457)

A kicksorter is an instrument designed to measure the amplitude distribution of pulses produced in an ionization chamber or other source. The general requirements of such an instrument are discussed, and the way in which the present instrument has been designed to meet the requirements is described. The several units comprising the complete kicksorter are then described in detail. Among these units are a combined discriminator and canceling circuit and an automatic d-c level control, both of which are new and which are shown to contribute effectively in attaining the high degree of stability and the simplicity of adjustment of the complete instrument. (auth)

855

Naval Radiological Defense Laboratory
SILVER-BEARING PHOSPHATE GLASSES AS DOSIMETERS. Raymond S. Alger. Oct. 17, 1950. 16p. (AD-259(P); Technical Objectives SR-02a, AW-05a)

Silver-bearing phosphate glasses were activated by exposure to x rays, and the fluorescent yield as measured under ultraviolet illumination was used as a basis for x-ray dosimetry. Glasses containing 8, 12, and 16% silver were found to be sufficiently sensitive for use as casualty badges except in the 1-Mev region, where greater sensitivity would be desirable. Phosphate glass in plate form was found to be more stable than phosphate glass in powdered form, and an increase in sensitivity was noted with an increase in silver content. It was concluded that dosimeters of phosphate glass would be satisfactory for use as casualty badges where using a reader to measure the dose would not be a disadvantage. (auth)

856

THE MEASUREMENT OF THE MAGNETIC FIELD IN A NUCLEAR SPECTROMETER. L. M. Langer and F. R. Scott. Rev. Sci. Instruments 21, 522-3(1950) June.

An arrangement is described which gives a continuous measurement of the relative magnetic field strength in a nuclear spectrometer with an accuracy of about 0.1%. The method consists in balancing the a-c voltage picked up by a coil rotating in the field of the spectrometer against that picked up in a standard Helmholtz field. (auth)

857

A METHOD OF MEASURING SPURIOUS COUNTS IN GEIGER-MÜLLER COUNTERS. D. Willard and C. G. Montgomery. Rev. Sci. Instruments 21, 520-1(1950) June.

A counter was excited by a series of x-ray pulses of short duration occurring at regular intervals. Spurious counts

were then easily recognized since they occur between the x-ray pulses. The counter pulses were displayed on an oscilloscope screen with a synchronized sweep, and the counter dead time, recovery time, and number of spurious counts determined by inspection. More quantitative information of the time distribution was obtained with an electronic circuit that recorded counts in a small arbitrarily chosen interval. It was found that the interval distribution shows at least two maxima. A mechanism is suggested for the appearance of the second maximum in terms of negative ions formed at the cathode by positive-ion bombardment. (auth)

858

ON A SECONDARY-ELECTRON COUNTER OF PHOTONS. S. F. Rodionov and A. L. Osherovich. Doklady Akad. Nauk S.S.S.R. 74, 461-3(1950) Sept. 21. (In Russian)

A photon counter involving the device invented by Kubetskiĭ, under the name of secondary-electron tube, is described. It has a Sb-Ce cathode and is cooled by liquid air. The cooling reduces the background (dark) photoelectron emission to 12 to 45 pulses/min, permitting measurements of photon beams of 10^{-14} to 10^{-15} lumen intensity in the visible part of the spectrum (3600 to 6500 A).

859

PERFORMANCE OF CADMIUM SULFIDE AS A DETECTOR OF X-RADIATION. John E. Jacobs. J. Optical Soc. Am. 40, 798(1950) Nov. (Proceedings of the O.S.A. contributed papers)

The article is reproduced here in its entirety.

CdS crystals were irradiated with 1.54-deg pulsating x radiation, and the a-c component of crystal current was measured. The very long delay in reaching steady-state conditions observed when the d-c component is measured was eliminated by this means. When a secondary illumination of constant magnitude is applied to the crystal while it is irradiated with pulsating x rays, it is found that the characteristics of the crystal are altered greatly. Green light increases the yield while red and blue lights decrease the yield. Crystals having lattice defects as evidenced by asterism in Laue patterns were found to have random noise currents as well as to exhibit erratic multiplication processes. Crystals have been subjected to total quanta exceeding 10^{12} with no apparent change in characteristics. It is necessary to irradiate the region adjacent to the negative electrode to achieve maximum output currents. If the x-ray beam is confined to a narrow region adjacent to the negative electrode, blocked for a period and suddenly applied, a current in excess of the steady-state value is observed. This effect is modified by use of a secondary illumination.

860

PHOTO-ELECTRIC MEASUREMENTS OF THE DENSITY OF TRACKS IN NUCLEAR EMULSIONS. Sten von Friesen and Krister Kristiansson. Nature 166, 686(1950) Oct. 21. (Letter to the editor)

Grain counting is impractical for heavily ionizing particles in electron-sensitive emulsions such as Ilford G5. The density of the tracks in such cases can be measured by a photoelectric method. A slit was mounted in the eyepiece of a microscope, and the divergent light passing through the slit was allowed to fall on the cathode of a photomultiplier tube. A portion of the track was adjusted symmetrically in the slit, and the resulting photocurrent was measured in terms of the current without track. The results of such measurements for 55 tracks from G5 plates exposed during a balloon flight to an approximate altitude of 20 km are given. The length of the slit corresponds to 30 μ of track length. It is possible to distinguish with certainty between π and μ mesons. The method is also well suited to tracks from heavy particles.

MESONS

861

University of California Radiation Laboratory
THE PRODUCTION OF MESONS BY PROTONS ON DEUTERONS. H. P. Noyes. July 28, 1950. 25p. (UCRL-710 (Rev.))

An attempt is made to predict the energy and angular distribution of charged mesons to be expected from the bombardment of deuterium by 345-Mev protons, assuming that the cross section for production in two nucleon collisions is known. The problem is simplified with the assumption that the third particle enters the reaction only by giving to the struck particle a momentum distribution at some time previous to the meson production, by carrying off the complementary momentum, and by limiting the states available through the exclusion principle. The possibility of the reformation of a deuteron more than doubles the cross section for the production of positive mesons if it occurs.

862

University of California Radiation Laboratory
LARGE ANGLE SCATTERING OF π^- MESONS. H. Bradner and B. Rankin. Sept. 12, 1950. 5p. (UCRL-910)

An investigation is being made of the mean free path for large-angle scattering and nuclear interaction of π^- mesons in G-5 emulsion. Mesons entering the edge of a plate with approximately 38-Mev energy are identified by measurement of grain density versus small-angle scattering. These mesons are then followed for several millimeters until they leave the 600-μ emulsion or reach an energy of 30 Mev. The average nuclear area for the elements in a G-5 emulsion is equivalent to a mean free path of 23 cm. Within the limits of the poor statistics it appears that the cross section for large-angle scattering of 20 to 38 Mev π^- mesons in emulsion is roughly equal to 1/2 nuclear area, while the cross section for star production is smaller. Other possible meson reactions are discussed briefly.

863

EVIDENCE OF THE MULTIPLE PRODUCTION OF MESONS IN A SINGLE NUCLEON-NUCLEON COLLISION. J. J. Lord, Joseph Fainberg, and Marcel Schein. Phys. Rev. 80, 970-3(1950) Dec. 15.

Evidence has been obtained for the multiple production of mesons in a single nucleon-nucleon collision in a photo-

graphic emulsion exposed to the cosmic radiation at an altitude of 95,000 ft. The nuclear encounter in which the mesons were created was produced by a primary proton of 3×10^{13} ev energy. Directly in line with the incident proton, 7 particles of mimimum ionization were emitted in a central core with an angular divergence of 0.003 radian. In addition, 8 other minimum-ionization particles were emitted in a wider diffuse cone of 0.13 radian angular divergence. Only one track had the appearance of a fragment which, however, could have been a proton of 10-Mev energy. Most of the particles in the central core had energies in excess of 250 bev, while those in the diffuse cone were of much lower energies as determined by small-angle scattering measurements. A pair of very small angular divergence was produced in the central core 4800 μ from the point of origin of the nuclear interaction. On the assumption that the pair was produced by a γ ray from the decay of a neutral meson, a lower limit of 2×10^{-15} sec was deduced for its mean life. Both the angular and the energy distribution of the emitted particles is in good agreement with the assumption that in the center-of-mass system the mesons are emitted in two distinct cones of angular width of about 30 deg forward and backward with reference to the direction of the primary proton. The average multiplicity of 15 agrees with the recent calculation by Fermi (private communication), and according to his prediction about one-half of the particles could be made up of nucleon-antinucleon pairs. (auth)

864

GENERATION OF MESONS BY PHOTONS. G. Morpurgo. Nuovo cimento 7, 855-67(1950) Oct. 15. (In Italian)

In connection with recent experiments at Berkeley on the production of mesons by photons, the differential cross section for the process is calculated in the first approximation of the perturbation theory by use of both pseudoscalar theory for the pseudoscalar coupling and scalar theory for the scalar coupling and by taking into account the recoil of the nucleons. This latter consideration is always important when high-energy photons are concerned; for low-energy photons it proves essential in the pseudoscalar treatment of the problem. While the two theories differ in the calculated values of the differential cross section, they furnish the same value for the ratio between the numbers of negative and positive mesons created, that value agreeing with the experiment. For high photon energies, this ratio varies rapidly with the angle (with respect to the photon's trajectory); e.g., for 10 bev, it is ~1 at 0 deg and ~120 at 90 deg. On the other hand, the ratio between the total cross sections for the production of a negative and a positive meson is ~2. (auth)

METEOROLOGY

865

SONIC PRECIPITATION OF SMOKE, FUMES AND DUST PARTICLES. Melvin Nord. Chem. Eng. 57, No. 10, 116-19(1950) Oct.

Brief discussions on sonic precipitation theory, collision mechanisms such as orthokinetic coagulation and hydrodynamic factors, history, smoke abatement, patents, and predictions are included. 48 references.

MOLECULAR PROPERTIES

866

DISSOCIATION CROSS SECTIONS FOR FAST HYDROGEN MOLECULE IONS. E. E. Salpeter. Proc. Phys. Soc. (London) 63A, 1295-7(1950) Nov. 1. (Letter to the editor)

In view of proposed measurements of the dissociation cross section of H_2^+ ions accelerated to 1 to 20 Mev, during a collision with stationary gas molecules or atoms, an approximate estimate of that cross section is made for collisions with H, N, O, and A atoms. The dissociation takes place mainly by exciting higher electronic states of H_2^+, and only in rare cases through excitation of nuclear vibrations (see Teller, Z. Physik 61, 458(1930)). The cross section is inversely proportional to the kinetic energy and increases with the atomic number Z of the hit atom faster than Z but more slowly than Z^2.

NEUTRONS

867

Knolls Atomic Power Laboratory
THE COMPLETE SOLUTION OF THE ONE-VELOCITY DIFFUSION PROBLEM AT INTERMEDIATE AND LARGE DISTANCES. L. Tonks. Aug. 3, 1950. 13p. (KAPL-385)

An approximate evaluation of the branch cut integral which occurs in the rigorous solution of the Boltzmann equation for intermediate and large distances leads to equations for the point source and for the plane source. It is shown that the branch cut term is not simply the contribution of non-collided neutrons. A formula for the distance at which the two terms are equal is developed for ratios of capture to total cross section greater than 0.6.

868

NEUTRON YIELDS FROM PHOTO-DISINTEGRATION BY GAMMA-RAYS FROM LITHIUM. B. D. McDaniel, R. L. Walker, and M. B. Stearns. Phys. Rev. 80, 807-12(1950) Dec. 1.

The relative neutron yield of 33 elements has been studied using the γ-ray spectrum which arises from proton bombardment of Li. The samples which were to be irradiated were placed in a block of paraffin. The neutrons were detected using four boron trifluoride proportional counters. Absolute γ-ray and neutron-intensity measurements yielded the value 0.055 ± 0.012 barn for the (γ,n) cross section of Cu. Rough indications were also obtained concerning the relative neutron energy distribution from the samples. (auth)

NUCLEAR PROPERTIES

869

Carnegie Institute of Technology
TOTAL NEUTRON CROSS-SECTION OF THORIUM AT 14 MEV. Albert H. Lasday. Sept. 15, 1950. Decl. Nov. 17, 1950. 2p. (AECD-3018)

The report is reproduced here in its entirety.

The total neutron cross section of Th was obtained from a transmission measurement using neutrons from the University of Pittsburgh cyclotron. Neutrons in the energy range 13 to 15 Mev were detected by allowing the neutron beam to impinge on a polyethylene radiator and then detecting recoil protons by passing them through a triple-coincidence, anticoincidence proportional-counter telescope (described in doctoral thesis, A. H. Lasday, Carnegie Institute of Technology, or report on Office of Naval Research Project No. NR-022106), with suitable Al absorbers for establishing the sensitive energy range. The mean energy was 13.9 Mev. The Th cross section obtained by this experiment was 6.11 ± 0.33 barns. The standard deviation of 0.33 barn is based on counting statistics (Rose and Shapiro, Phys. Rev. 74, 1853(1948); or AECD-2197) of the experiment. The cross section was calculated from the measured transmission using a measured specific gravity of the thorium sample of 11.50. The cylindrical sample was 10.18 cm long by 5.70 cm in diameter. The geometry of the experiment was good, since the Th scatterer, placed midway between cyclotron and proportional-counter telescope, subtended a plane angle of 4.2 deg at either source or detector. The detector subtended a plane angle of 5 deg at the Th scatterer. Hence it was necessary to correct the observed cross section for the effect of elastically scattered neutrons. This correction was calculated using the method of McMillan and Sewell (MDDC-1558; or Phys. Rev. 75, 14(1949)). This correction amounted to 5.5%. The Th cross section of 6.11 ± 0.33 barns agrees quite accurately with the cross sections measured by Amaldi et al. (Nuovo cimento 3, 203(1943)); or "Report of an International Conference on Fundamental Particles and Low Temperatures," Vol. I, "Fundamental Particles," p.97, London, The Physical Society, 1947) at 14 Mev. Using the well-known formula relating nuclear radius, R, to total neutron cross section σ_t: $\sigma_t = 2\pi R^2$, the best fit to Amaldi's data is given by the straight line: $R = (1.3 + 1.37A^{1/3}) \times 10^{-13}$ cm. This formula gives a Th radius of 9.7×10^{-13} cm, and the measured cross section leads to a Th radius of $(9.86 \pm 0.24) \times 10^{-13}$ cm.

870

University of Wisconsin
EXCITED STATES OF C^{11} AND C^{12}. Virgil R. Johnson. [nd.] 1p. (AECU-1040)

The report is reproduced here in its entirety.

Thin (100-kev) targets of B^{10} and/or ordinary B on Ta backings were bombarded with monoenergetic deuterons of 3.4- and 3.6-Mev energy. Eastman NTA 200-μ nuclear emulsion plates were mounted 10 cm from the target at 0 and 80 deg with respect to the incident beam. Altogether about 3000 tracks have been measured. The neutron groups definitely assigned to the $B^{10}(d,n)C^{11}$ reaction give energy levels in C^{11} at 1.9, 4.3, 4.85, 6.48, 6.83, 8.45, and 8.70 Mev. Other much weaker intensity groups are observed whose assignment is still uncertain. The work on the $B^{11}(d,n)C^{12}$ reaction shows well-defined groups corresponding to C^{12} levels at 15.14, 15.59, and 16.12 Mev and much broader poorly defined groups giving a C^{12} excitation of 4.6, 7.3, 9.7, 10.4, and 11.9 Mev. There are also other possible unresolved levels in C^{12} between 12- and 15-Mev excitation.

871

THE NEUTRON CROSS SECTION OF Mn BELOW 5000 EV. S. P. Harris, C. T. Hibdon, and C. O. Muehlhause. Phys. Rev. 80, 1014-18(1950) Dec. 15.

Experimental measurements of the neutron scattering and absorption cross sections of manganese at energies less than 5000 ev are shown to fit a two-level Breit-Wigner formula. Only one parameter, the nuclear radius, need be adjusted to do this. This adjustment having been made, it is possible to obtain (a) the total scattering, the coherent scattering, and the absorption cross section for thermal neutrons, (b) the angular momenta of the two low-energy resonances, and (c) the proper cross-section behavior in the wing of the lowest-energy resonance. The evidence presented demonstrates in detail that the Breit-Wigner formulation yields the proper neutron-scattering cross section as a function of energy. (auth)

872

NUCLEAR MAGNETIC RELAXATION AND RESONANCE LINE SHIFT IN METALS. J. Korringa. Physica 16, 601-10(1950) July-Aug.

A detailed theory is given of the nuclear relaxation time in metals. The 1/T law of Heitler and Teller, which is imposed by the statistics of the electrons, is obtained by using the Bloch approximation of metals. An approximate relation is derived between the relaxation time τ and the relative line shift $\Delta H/H$, viz., $\tau(\Delta H/H)^2 = \hbar/\pi kTg^2$ where g is the nuclear g factor in Bohr units. The experimental results on Li^7, Al^{27}, and Cu^{63} are discussed with special reference to the influence of the correlation between the electrons. The deviations from the 1/T law for Li are all or nearly all attributed to the influence of paramagnetic impurities. (auth)

873

REVISION OF THE HYPERFINE STRUCTURE OF THE MERCURY SPECTRUM. Kiyoshi Murakawa and Shigeki Suwa. J. Phys. Soc. Japan 5, 429-34(1950) Nov.-Dec.

The hyperfine structure of λ5790, λ5789.7, λ5769 and λ4047 of the spectrum of Hg(I) was studied, and the structure of some terms was determined. The ratio of the hyperfine structure constant of Hg^{199} to that of Hg^{201} was calculated for the terms $6p\ ^1P_1$, $6p\ ^3P_2$, and $7s\ ^3S_1$, and it was found that the ratio is anomalous for the term $6p\ ^1P_1$. The quadrupole moment of Hg^{201} was calculated to be $0.3_8 \times 10^{-24}$ cm^2. Regularity in the displacement of even isotopes in lines of the mercury spectrum was found to exist in such a way that the ratio of the spacings Hg^{204}-Hg^{202}: Hg^{202}-Hg^{200}: Hg^{200}-Hg^{198} is constant for all lines examined and is equal to 1 : 0.933 : 0.880. The same qualitative regularity was found in the isotopic displacement in lines of heavy elements consisting of at least three even isotopes. 13 references. (auth)

874

SUPERCONDUCTIVITY AND NUCLEAR MASS. Chem. Age (London) 63, 679(1950) Nov. 11.

Note is made of the relationship, discovered at the U. S. Bureau of Standards, between the temperature at which

Hg and Sn isotopes become superconductive and their nuclear mass. (see J. Franklin Inst. 250, 358(1950) Oct.)

NUCLEAR REACTORS

875

ELEMENTARY PILE THEORY. H. Soodak and E. C. Campbell. Uspekhi Fiz. Nauk 42, 93-156(1950) Sept. (In Russian)

This is a translation into Russian of the above book, published by John Wiley and Sons, Inc., New York, 1950.

NUCLEAR TRANSFORMATION

876

University of Wisconsin
ELASTICALLY SCATTERED PROTONS FROM CARBON. Gerson Goldhaber, R. M. Williamson, H. L. Jackson, and M. J. W. Laubenstein. [nd.] 1p. (AECU-1041)

The report is reproduced here in its entirety.

Excited levels in N^{13} were investigated by observing the yield, at an angle of 164 deg of protons elastically scattered from carbon. Bombarding energies from 0.3 to 4.0 Mev were observed. A 90-deg magnetic analyzer was used to separate proton groups from carbon and the nickel backing. Only two resonances at 456-kev and 1.7-Mev proton energy, previously known (Fowler and Lauritsen, Phys. Rev. 76, 314(1949), Van Patter, Phys. Rev. 76, 1264(1949)) from the $C^{12}(p,\gamma)N^{13}$ reaction, were found. The differential cross section for elastic scattering at the two peaks was 0.54×10^{-24} and 0.94×10^{-24} cm^2/steradian, respectively. Absolute cross sections were determined to ±25%. Between the resonances, the yield maintains a level of 0.14×10^{-25} cm^2/steradian which is well above Rutherford scattering. Following the second resonance region, a lower plateau of 0.063×10^{-24} cm^2/steradian extends to about 3.5 Mev.

877

University of California Radiation Laboratory
RELATIVE HIGH ENERGY NEUTRON YIELDS FROM TARGETS BOMBARDED WITH PROTONS AND DEUTERONS. William J. Knox. Sept. 19, 1950. 23p. (UCRL-440(Rev.))

Relative neutron yields in the forward direction from various target elements bombarded with 340-Mev protons and 190-Mev deuterons have been measured. Bismuth fission chambers with a threshold of about 50 Mev were used to detect the high-energy neutrons. When a deuteron beam is used, the neutron yields for light elements agree with the values predicted by the deuteron stripping theory. For the heavy elements the observed values are fitted best by adding a function proportional to Z^2 to the stripping-theory values. This may be interpreted as evidence for the production of high-energy neutrons by the electric field disintegration of the deuteron. The neutron yields from the proton beam vary approximately as $(A - Z)^{2/3}$ for target elements from carbon to uranium. This indicates that the heavy elements are not completely transparent to 340-Mev protons. Beryllium has an anomalous neutron yield 50% higher than that for carbon. (auth)

878

University of California Radiation Laboratory
HIGH ENERGY PHOTO-NUCLEAR REACTIONS. Karl Strauch. Oct. 4, 1950. 34p. (UCRL-708(Rev.))

Transition curves in Pb of the photons responsible for various nuclear reactions have been obtained using 322-Mev bremsstrahlung from the Berkeley synchrotron. The area under these curves or "track length" determines an effective photon energy. The integrated cross sections of the reactions $C^{12}(\gamma,n)C^{11}$ and $Cu^{63}(\gamma,n)Cu^{62}$ are found to be 0.090 and 0.76 Mev-barn, respectively. Relative yields of various reactions from Zn have been measured, and relative cross sections have been calculated from these and the effective photon energies. A lower limit of 1.4 Mev-barns is obtained for the total cross section for photon absorption by the Zn nucleus, and 30 Mev is found for a lower limit to the average photon energy absorbed by the same nucleus. These results are discussed with respect to the proposed theories for nuclear photon absorption. (auth)

PARTICLE ACCELERATORS

879

Case Institute of Technology
THE EJECTION OF THE ELECTRON BEAM FROM THE BETATRON. Sherwood L. Fawcett and E. C. Crittenden, Jr. June 3, 1950. 14p. (NP-1807;Technical Report No. 1)

The betatron or synchrotron type of particle accelerator normally employs the electron beam internally to produce high-energy x rays. A collimated electron beam brought out of such a machine would be more useful for certain experiments since the ionization produced by the electrons is many times that of the x rays. The method of electron-beam ejection used in this experiment utilizes the perturbing magnetic field produced by a current pulse flowing in a pair of conductors, one above the other, placed inside the betatron vacuum donut above and below the orbital plane at the outer edge of the normal betatron field and extending over an azimuth of 40 deg. The experiments showed that this method is a practical one for ejecting the electron beam from the magnetic field of a betatron into a useful collimated beam.

880

Atomic Energy Research Establishment
A.E.R.E. (HARWELL) MACHINES FOR NUCLEAR PHYSICS. Sept. 1950. 5p. (AERE-G/M-69)

Brief descriptions are given of the cyclotron, synchrotrons, Van de Graaff generator, linear accelerator, and D-D generator, all of which are being used currently for nuclear physics research at Harwell, England. A brief description of the two Harwell piles is included for completeness.

RADIATION ABSORPTION AND SCATTERING

881

Brookhaven National Laboratory
SMALL ANGLE SCATTERING OF THERMAL NEUTRONS (THEORETICAL). (abstract) R. J. Weiss and S. Pasternack. Sept. 25, 1950. 1p. (AECU-1071)

The report is reproduced here in its entirety.

The differential and total cross sections for small-angle scattering of thermal neutrons by spheres have been calculated. Asymptotically the results are identical with those obtained from geometrical optics (refraction) or from the Born approximation (diffraction), depending on whether the difference, ρ, between the neutron phase change in traversing the particle diameter and the phase change in traversing the same distance in vacuo is large or small, respectively. For large values of ρ the angular dependence of the differential cross section is a function only of δ, the difference from unity of the index of refraction, and the total cross section is $2\pi R^2$. For small ρ the central diffraction maximum has a half width proportional to λ/R; the total cross section being $\pi R^2\rho^2/2$. When the sphere is part of a conglomerate, coherence effects must be considered for ρ small, but for ρ large the scatterings can be considered independent. In the latter case the multiple-refraction theory of Von Nardroff is approximately valid. The above considerations may be applied to shapes other than spheres, and to ferromagnetic domains.

882

ON THE BOMBARDMENT OF Li_2O AND C BY ALPHA-PARTICLES AND DEUTERONS. Isadore B. Berlman. Phys. Rev. 80, 775-81(1950) Dec. 1.

Photographic nuclear emulsions were used to record the scattered and recoiling particles when Li_2O and C targets were each independently bombarded by 10-Mev deuterons and 20-Mev α particles. The 1.0-Mev level in C^{13} has been confirmed and a new level at 6.8 Mev in C^{13} has been determined. The relative scattering of deuterons and α particles from nuclei in the ground state and in their various nuclear energy levels is illustrated. Finally, the α particle range-energy curve, as applied to Ilford E-1 nuclear emulsions, has been modified at higher energies. (auth)

883

THE RAYLEIGH SCATTERING OF 0.41 MEV GAMMA-RAYS AT VARIOUS ANGLES. A. Storruste. Proc. Phys. Soc. (London) 63A, 1197-1201(1950) Nov. 1.

A report is given on some measurements of the Rayleigh cross section for scattering of 0.41-Mev γ rays by Pb, Cu, and Al. At small angles the Rayleigh cross section in Pb is found to decrease rapidly with increasing angle of scattering from approximately 12 times the Compton cross section at 3 deg to a value equal to the Compton cross section at 12 deg. In Cu the Rayleigh cross section is found to equal the Compton cross section at 4.5 deg. In Al no substantial excess scattering above the Compton cross section is found, the smallest angle at which measurements were taken being 3 deg. At 60, 90, 120, and 150 deg the hard component of the scattered radiation from Pb is found to be respectively 1.77, 1.14, 0.88, and 0.66% of the Compton component as calculated by the Klein-Nishina formula. (auth)

884

SCATTERING OF MESONS BY NUCLEAR PARTICLES. Vachaspati. Phys. Rev. 80, 973-6(1950) Dec. 15.

Cross sections for the scattering of mesons by nuclear particles are obtained quantum-mechanically on the basis of the Heitler-Peng version of the perturbation theory. The integral equation taking account of radiation damping in the quantum theory is solved in the classical approximation ($\hbar \to 0$). A comparison of these cross sections with those obtained classically reveals certain discrepancies. It is found that though they broadly agree in most cases, usually some higher-order terms which occur in the purely classical treatment are absent in the quantum-mechanical one. The discrepancy is further accentuated in the case of g_0-scattering, where the differential cross sections have generally very different angular dependences and differ also in numerical coefficients. These differences are, in general, such that they cannot be accounted for by postulating quantized orientations of the spin. The correspondence suggests the lines along which a new theory of radiation damping may be developed.

RADIOACTIVITY

885

Iowa State College Ames Laboratory
BETA-SPECTRUM OF As^{77}. Erling N. Jensen, R. T. Nichols, and J. Clement. [nd.] 6p. (AECU-1031; Contribution No. 28)

Conflicting values of the maximum energy of As^{77} β rays are found in the literature. A sample of As^{77} has been separated from pile-irradiated germanium dioxide and its radiations have been examined with a thin-lens β-ray spectrometer. The β spectrum and the allowed Kurie plot are shown. By the method of least squares, using the points with $W > 1.65\ mc^2$, the maximum energy is found to be $2.330\ mc^2$, giving a maximum kinetic energy of 0.679 ± 0.004 Mev. No internal conversion lines were observed. A search was made for photoelectron lines using a Pb foil, but none was found. However, the source was very weak and therefore the evidence is not conclusive. Using a half-life of 38 hr, the ft value is calculated to be 4.7×10^5. With assignments of $p_{1/2}$ and $p_{3/2}$ states for Se^{77} and As^{77}, respectively, this value is in good agreement with predictions of the nuclear shell model.

886

NEPA Division
DECAY FACTORS FOR THE COMPUTATION OF SATURATED ACTIVITY OF INDIUM FOILS. R. H. Lewis. Sept. 11,1950. 144p. (NEPA-1558)

An equation for the saturated activity of a foil exposed to a constant thermal-neutron flux for a finite period of time has been derived. Factors in this equation are exponential functions of exposure time, count time, and wait time. These factors have been calculated for indium decay at 0.5-min intervals from 0 to 633.5 min, the decay constant λ being taken as 0.012836/min. Table I lists $e^{-\lambda t}$, $1-e^{-\lambda t}$, and their reciprocals. Table II covers specific combinations of exposure time and counting time. When the counting time and exposure time are as indicated in column headings, the saturated activity may be obtained by multiplying the one factor in the column by the net counts.

887

University of California Radiation Laboratory
AUGER EFFECT IN ASTATINE. Lawrence S. Germain. Mar. 1, 1950. 9p. (UCRL-770)

The K capture decay of At^{211} has been studied using photographic emulsions. The number of Auger electrons per K shell vacated, defined as the Auger coefficient, has been found to be 0.106. This value is somewhat higher than that calculated from theory. Bi^{207}, which arises from the alpha decay of At^{211}, was observed to decay by K capture. (auth)

888

University of California Radiation Laboratory
SOME NEUTRON-DEFICIENT STRONTIUM ISOTOPES. Stanley Vernon Castner. Oct. 16, 1950. 51p. (UCRL-942)

Half-lives and radiation characteristics have been determined for three new strontium isotopes with mass number lower than 84 which were produced by bombarding RbCl with 25- to 100-Mev protons. Sr^{81} has a 28-min half-life and emits positrons and conversion electrons and possibly K x rays, the energies of which have not been established. Sr^{82} emits positrons with 3.15 ± 0.03-Mev energy limit, at least two lines of conversion electrons corresponding to γ-ray energies of 0.15 and 0.40 Mev, K x rays, and γ rays of 0.95- and 0.15-Mev energy. The half-life is 25.5 days. Sr^{83}, of 38-hr half-life, emits positrons of 1.15 ± 0.05-Mev energy limit, five pairs of lines corresponding to K and L conversion of γ rays of 0.040-, 0.074-, 0.101-, 0.151-, and 0.165-Mev energy, K x rays, and γ rays. Some observations on the 107-day Rb^{83} daughter of Sr^{83} indicate the presence of K x rays, a γ ray of 0.8-Mev energy, and two lines of conversion electrons corresponding to γ rays of approximately 0.15- and 0.45-Mev energy.

889

University of California Radiation Laboratory
LONG-LIVED Bi^{207} AND ENERGY LEVELS OF Pb^{207}. H. M. Neumann and I. Perlman. Oct. 9, 1950. 22p. (UCRL-946)

The long-lived isotope of bismuth, Bi^{207}, has been prepared by deuteron irradiation of lead and from the α decay of At^{211}. From the genetic relationship with At^{211}, the half-life is estimated to be 60 yr. The conversion-electron spectrum has been determined and is discussed in terms of the energy states of Pb^{207}. Further evidence on these states has been obtained from the discovery of three rare α groups in the decay of Po^{211} of energies 6.90, 6.57, and 6.34 Mev which are compared with the main group at 7.43 Mev. (auth)

890

University of California Radiation Laboratory
BETA DECAY ENERGY OF Ac^{226}. K. L. Hall and D. H. Templeton. Oct. 20, 1950. 6p. (UCRL-957)

The β-decay energies of isotopes for which β transitions have not yet been observed may be calculated by closing decay cycles based on estimations from α systematics and available experimental evidence. In order to lend more credence to decay values in the region of Cm^{230} estimated in this manner, an experimental check of the β-decay energy of Ac^{226} has been made. Aluminum absorption curves and a Kurie plot of Ac^{226} separated from Th foil bombarded with 350-Mev protons give a β-decay energy of 1.17 ± 0.10 Mev. There is no observable γ tail in the absorption curve, indicating that Ac^{226} is nearly a pure β emitter.

891

THE AVERAGE LIFE OF THE DISINTEGRATION OF TELLURIUM. Ciencia e invest. (Buenos Aires) 6, 509 (1950) Nov. (In Spanish)

This is a note on the study made by Inghram and Reynolds (Phys. Rev. 76, 1265(1949); AECU-464; NSA 3-2013) of the decay of isotopes of Te in minerals, and on the bearing of that study on the comparative merits of Majorana's and Dirac's theories of the neutrino.

892

BETA-DECAY OF ISOMERIC Cd^{115}. W. L. Carss, Jane R. Gum, and M. L. Pool. Phys. Rev. 80, 1028-9(1950) Dec. 15.

Deuteron bombardment of Cd was found to produce a 5.1 ± 0.3-hr activity in the Cd fraction. Comparison of yields from Cd targets enriched in isotopes 112, 113, 114, and 116 led to assignment of the activity to an isomer of the stable Cd^{113} isotope. Instead of the usual decay to the ground state by γ rays, β rays of 0.5 Mev are emitted to form In^{113}. X rays are also observed.

893

Atomic Energy Research Establishment
A CLOUD-CHAMBER STUDY OF THE β-RAY SPECTRUM OF HOLMIUM 166 AND THULIUM 170. G. F. Snelling and E. W. Titterton. Sept. 1, 1950. 7p. (AERE-G/M-55)

Cloud-chamber and absorption determinations of the end points of the β-ray spectra of Ho^{166} and Tm^{170} have been made and values of 1.92 and 1.01 Mev, respectively, are found. Both transitions can be classified as second-forbidden. (auth)

894

GAMMA-RAYS FROM $Be^9(\alpha,n)$. James Terrell. Phys. Rev. 80, 1076-80(1950) Dec. 15.

The γ-ray spectrum produced by bombarding Be^9 with polonium γ particles has been analyzed by means of a 180-deg focusing pair spectrometer. The spectrum shows a single γ ray of energy 4.45 ± 0.09 Mev. The 6.7-Mev γ ray reported by earlier observers is not detected: none is present in the range 6 to 11 Mev to the extent of 0.5% of the 4.45-Mev intensity.

895

THE NATURAL RADIOACTIVITY OF In^{115}. E. A. Martell and W. F. Libby. Phys. Rev. 80, 977-82(1950) Dec. 15.

An investigation of the possible natural radioactivities of the Cd^{113}-In^{113} and In^{115}-Sn^{115} pairs of adjacent isobars gave evidence for a natural β radioactivity of In. Four samples of In differing in geographical origin were subjected to

radiochemical purification and then examined in a screen wall counter arranged with anticoincidence counters and steel shielding. Absorption measurements on these samples gave reproducible results indicative of an energetic natural β radiation. The energy was measured by comparing the absorption characteristics of the In radiation with those of Tl^{204} and Co^{60}, whose β energies have been measured spectroscopically. Measurement of isotopically enriched samples of In gave conclusive evidence that the origin of the β radiation is the In^{115}. Limits were placed on possible accompanying γ radiation. The results indicate that In^{115} emits a natural β radiation of 0.63 ± 0.03-Mev energy with a half-life of $6 \pm 2 \times 10^{14}$ yr. (auth)

896

A PRECISE DETERMINATION OF THE HALF-LIFE AND AVERAGE ENERGY OF TRITIUM DECAY. G. H. Jenks, F. H. Sweeton, and J. A. Ghormley. Phys. Rev. 80, 990-5(1950) Dec. 15.

A precise determination of the half-life of T and of the average energy released by its decay has been carried out. The half-life was determined from measurements of the quantity of T contained in a sample and the rate at which that quantity gave rise to He^3. The average energy release was determined from additional measurements on the same sample of the rate at which the sample liberated heat. The value found for the half-life was 12.46 ± 0.1 yr. That found for the average energy released by decay of neutral T to neutral He was 5.69 ± 0.04 kev. (auth)

897

RADIOACTIVITY OF POTASSIUM AND HEAT PRODUCTION IN THE EARTH. G. V. Voitkevich. Doklady Akad. Nauk S.S.S.R. 74, 771-3(1950) Oct. 1. (In Russian)

Recently obtained values of decay coefficients of U^{235} and K^{40} necessitated a revision of calculations on radioactive sources of heat in earth. The following are the corrected data:

	At present	2×10^9 yr ago	3×10^9 yr ago	4×10^9 yr ago
Total, 10^{16} cal/hr	47.12	77.69	115.05	188.09
U^{238}, %	45	38	30	20
U^{235}, %	2	8	15	23
Th^{232}, %	43	29	20	14
K^{40}, %	10	25	35	43

The importance of K^{40} decay in the heat balance of the earth in the past is manifest. The fact that potassium is mainly concentrated in the outer layers of the globe must have strongly influenced the thermodynamical conditions of the formation of the primordial crust. However, other heat sources now extinct or exceedingly slow, such as fissions of heavy elements, were perhaps predominant in those times.

898

Los Alamos Scientific Laboratory
TABLES FOR β-DECAY SYSTEMATICS. L. W. Nordheim. May 1950. 21p. (NP-1769)

An interim paper containing tables of β-decay data and orbital assignments for odd A nuclei and for even A nuclei, with related information, is presented.

SHIELDING

899

Argonne National Laboratory
TEST OF DENSE CONCRETE WITH IRON PUNCHINGS FOR CAVE CONSTRUCTION. Donald F. Uecker, Kenneth R. Ferguson, Dudley G. Seay, and Charles B. Webster. July 11, 1949. Decl. Nov. 24, 1950. 7p. (AECD-3013; ANL-4319)

Progress made on the development of dense concrete for γ-ray shielding, using steel punchings as aggregate, is reported. Conventional mixing and placement methods are precluded because of excessive honeycombing. Shielding enclosures prepared by vibrating the punchings into grout are illustrated and show definite promise.

SPECTROSCOPY

900

Naval Research Laboratory
INFRARED SPECTRA OF PHOSPHORUS COMPOUNDS. L. W. Daasch and D. C. Smith. Apr. 1950. 57p. (NRL-3657)

Infrared spectra of 60 phosphorus compounds have been obtained and used to formulate a basis for the practical application of infrared methods to phosphorus chemistry. Through correlation of absorption with molecular structure, characteristic frequencies are proposed for P-H, P-D, P-F, P-Cl, P-C(aliphatic), P-OH(acidic), P-O-C (ester), phenylphosphorus, phosphoryl, and thiophosphoryl groups. The use of these frequencies for determination of molecular structure of phosphorus compounds is discussed and illustrated, and spectral methods for compound identification and analysis are pointed out. The phosphoryl bond is shown to have polar characteristics and to be close to a double bond in strength. The implications of these facts as regards the electronic nature of the bond are also discussed. A vibrational assignment and practically complete interpretation for the infrared and Raman spectra of trimethylphosphine oxide are included in an appendix. (auth)

THEORETICAL PHYSICS

901

GEOMETRIC DEMONSTRATION OF THE TENSOR EQUATIONS OF THE PHOTON; COMPLEXITY OF THE PARTICLE WITH SPIN EQUAL TO 1. Georges Bodiou. Compt. rend. 231, 568-70(1950) Sept. 18. (In French)

If, in defining the symmetry of a spinor, the convention $\xi' = iAK\xi$ in the notation of Cartan, and the corresponding $\psi' = -A\psi$ in the Dirac-Neumann-de Broglie representation are chosen, the Dirac equations are shown to express the invariance of the wave spinor ψ by a symmetry with respect

to a hyperplane perpendicular to the unit vector P/imc; they may be written $-(P/imc)\psi = \psi$. The de Broglie equations of the photon are shown to be equivalent to the hypothesis that the photon is a complex particle formed by two Dirac corpuscles.

902

Naval Research Laboratory
ON SOME MATHEMATICAL METHODS IN THE THEORY OF SCATTERING OF PARTICLES; PART I; trans. from Zhur. Eksptl'. i Teoret. Fiz. 18, 337-45(1948). I. E. Tamm; tr. by A. Pingell. 1949. 15p. (NRL-TRANS-245)

The report presents a translation of the above article, an abstract of which appears in NSA as abstract 1-1689.

TRITIUM AND TRITIUM COMPOUNDS

903

Technical Information Division, ORE, AEC
TRITIUM (H^3); A BIBLIOGRAPHY OF UNCLASSIFIED LITERATURE. Fred E. Croxton and Simone B. Schwind, comps. Aug. 25, 1950. 33p. (TID-371)

This bibliography, arranged chronologically, consists of 250 references covering the period 1933 to 1950. Indexes to authors, subjects, and report numbers are included. The references listed cover primarily the nuclear and physical properties of tritium; a few articles on its use in tracer studies are included.